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USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS

ELECTRONICS AND ELECTRICAL ENGINEERING

No. 35

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## USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS

## ELECTRONICS AND ELECTRICAL ENGINEERING

No. 35

This serial publication contains abstracts of articles and news items from USSR and Eastern Europe scientific and technical journals on the specific subjects reflected in the table of contents.

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ELECTRONICS  
Amplifiers

USSR

UDC 621.317.66:621.375.146.6

MEASUREMENT OF THE MEAN EFFICIENCY OF HIGH-FREQUENCY POWER AMPLIFIERS

Moscow ELEKTROSVYAZ' [Electric Communication] in Russian No 7, Jul 77  
pp 52-57 manuscript received 21 Jun 76

ROZOV, V. M.

[Abstract] One of the principal means of improving power single-band transmitters is the development of methods for construction of amplifiers with an increased efficiency. The power effectiveness (PE) of transmitters (amplifiers) is evaluated by the efficiency  $\eta$ . Simple and single-valued methods for performing such evaluations are available in the case of devices with constant operating conditions. The present paper is concerned with development of a precise method of determining the efficiency of amplifiers with variable operating conditions (e.g., amplifiers of an amplitude-modulated or single-band high-frequency signal). Methods proposed at various times for evaluation of the PE of such devices are considered and recommendations made with respect to their use. It is shown that the mean efficiency can be a criterion of the PE. Figures 5; tables 1; references 8: 7 Russian, 1 Western.

USSR

UDC 621.375.4.001.5

EFFECT OF ANISOTROPY OF DIFFERENTIAL MOBILITY OF CARRIERS ON WAVE  
PROPAGATION IN THIN SEMICONDUCTOR FILMS

Moscow RADIOTEKHNIKA I ELEKTRONIKA [Radio Engineer and Electronics] in  
Russian Vol 22, No 8, Aug 77 pp 1680-1688 manuscript received 27 Apr 76

BARYBIN, A. A.

[Abstract] The paper analyzes the effect of anisotropy of differential mobility [ADM] (disregarding diffusion) on the nature of wave propagation in thin semiconductor films of n-GaAs type, both in the region of positive and in the region of negative longitudinal differential mobility of electrons. Input equations and a general analysis of dispersion relations are considered. The analysis of the dispersion equation in the limits of zero diffusion showed that the film supports propagation of hyperbolic and trigonometric modes. Hyperbolic modes exist only in a regime of positive ADM and always attenuate. The trigonometric mode exists in both positive and negative ADM. The mechanism of amplification in a thin-film travelling-wave amplifier is investigated. The mechanism is found to be connected with a spatial increase of the fundamental symmetrical mode ( $n = 0$ ) in the region of negative differential mobility. Damped higher modes ordinarily

play a negative role, leading to a decrease of the amplification factor and to a worsening of the noise properties of the amplifier. Figures 4; references: 24 Western (including Japanese).

USSR

UDC 621.375.4.029.64

#### K-BAND TUNNEL AMPLIFIER OF NONSYMMETRIC-MICROSTRIP CONSTRUCTION

Moscow RADIOTEKHNIKA I ELEKTRONIKA [Radio Engineering and Electronics] in Russian Vol 22, No 8, Aug 77 pp 1718-1721 manuscript received 16 Mar 76

MOSOYAN, K. S., MKRTUMYAN, K. A., and PARSAMYAN, S. S.

[Abstract] Because of a comparatively low noise and a wide transmission band, tunnel amplifiers (TA) are widely used in low-noise microwave receiving devices. The creation and investigation of small-size microstrip TA in the shortwave part of the centimeter range is of particular value. The present work is concerned with an experimental investigation of a reflex-type K-band TA of nonsymmetric-microstrip construction, as well as waveguide-microstrip adapters and Y-circulators, developed for work with TA. Use of thin-film technology made it possible to develop a K-band TA which has a power amplification of  $K_0 = 12$  db with a transmission band  $\Delta f = 7$  percent, a noise factor  $F = 6.5$  db, and small dimensions and weight. Such amplifiers can be used successfully for creation of small-sized microstrip K-band radiometers. Figures 9; references: 4 Russian.

USSR

UDC 533.951.2

THERMAL HIGH-FREQUENCY NOISE INDUCED IN A CIRCULAR APERTURE ANTENNA IMMERSED IN PLASMA

Moscow RADIOTEKHNIKA I ELEKTRONIKA [Radio Engineering and Electronics] in Russian Vol 22, No 8, Aug 77 pp 1735-1737 manuscript received 30 Mar 76

KARPLYUK, K. S.

[Abstract] Radiofrequency probes, i.e., small antennas immersed in plasma have long been used for measurement of such plasma parameters as the concentration and effective collision frequency of electrons. In order to make a quantitative conclusion concerning the temperature, it is necessary to compare the measured noise power with the theoretically calculated noise power induced in an antenna by plasma at a specific temperature. However, it is usually not possible to perform a precise calculation of the fluctuation power in an antenna. The present paper is concerned with a search for antennas, such that it is possible to perform an approximate calculation, compact in form and having a small error whenever possible. A circular aperture antenna is one of the antennas, convenient in operation and permitting a numerical calculation of the fluctuation power induced in it by plasma. Expressions are derived which make it possible to calculate the power absorption coefficient in the emission plasma which is created by such an antenna. The results are presented in the form of a graph with four curves. A method is given for using the results obtained to determine the temperature of the plasma. Figures 2; references 9: 3 Russian, 6 Western.

USSR

UDC 621.396.67

CALCULATION OF VECTOR DIAGRAMS FOR APERTURE ANTENNAS

Gorkiy IZV.VUZ:RADIOFIZIKA [Bulletin of Higher Educational Institutions; Radiophysics] in Russian Vol 20, No 7, Jul 77 pp 1091-1101 manuscript received 3 May 76

NARBUT, V. P.

[Abstract] A method is shown of plotting the cross-polarization field distribution over the aperture of an optical antenna for a given main-polarization field distribution. A general expression is derived from the fundamental vector distribution of a linearly polarized field, and then applied to both a parabolic reflector antenna and a dielectric lens antenna. The location of the peak on the cross-field distribution is found to depend on the coordinates as well as the polarization characteristic of the exciter.



An axisymmetric main-field distribution can only be synthesized when the radiation pattern of the exciter is known. In the case of reflector antennas with the ratio  $F/D \leq 0.25$  it is not feasible to achieve a uniform amplitude distribution with conventional exciters. Figures 7; references 4: 3 Russian, 1 Western.

USSR

UDC 621.396.67.012.12

FIELD CALCULATIONS BASED ON PHASOMETRIC (RADIOHOLOGRAPHIC) ANTENNA MEASUREMENTS

Gorkiy IZV. VUZ:RADIOFIZIKA [Bulletin of Higher Educational Institutions: Radiophysics] in Russian Vol 20, No 7, Jul 77 pp 1071-1077 manuscript received 23 Jan 76

TURCHIN, V. I., Scientific-Research Institute of Radiophysics

[Abstract] The radiation pattern, i.e., the angular distribution of the field intensity is calculated here from phasometric (radioholographic) readings as the integral of the tangential component of only the electric (or magnetic) field intensity, with the Green tensor of homogeneous Maxwell equations as the kernel and with a nonhomogeneous boundary condition at the antenna surface. The approximation of geometrical optics is used and the error of the radiation pattern caused by the response of a synphasal antenna to a point "source" in the path of the scanning beam is estimated. Figures 1; references 12: 9 Russian, 3 Western.

USSR

UDC 621.396.674.395

COPHASAL WIDE-BAND ANTENNAS WITH FIXED DIPOLES

Moscow ELEKTROSVYAZ' [Electric Communication] in Russian No 7, Jul 77 pp 33-39 manuscript received 17 Mar 76

BELOUSOV, S. P., KLIGER, G. A., and KUZNETSOV, V. D.

[Abstract] Cophasal wide-band antennas which use fixed short dipoles as radiators are described. A choice of the principal geometric dimensions of such an antenna is made on the basis of calculations and the results of experimental investigations on models of one section of a four-stage decimeter-band antenna. The electrical characteristics of the antenna

are also presented. It is noted that the cophasal wide-band antennas developed have a satisfactorily high value of the traveling-wave ratio in the distribution feeders, which makes it possible to use them for operation with high-power transmissions. The results of measurements of the electrical characteristics of existing SGD8/tRA antennas with fixed dipoles agree with the results of calculations and measurements on models. Figures 9; tables 1; references: 4 Russian.

USSR

UDC 621.396.677

#### ESTIMATING CHARACTERISTICS OF A DIRECTIONAL DIAGRAM FORMING UNIT

Moscow RADIOTEKHNIKA [Radio Engineering] in Russian No 8, 1977 pp 35-38  
manuscript received after completion, 21 May 76

DOLZHENKOV, A. A., ZIMIN, D. B. and POLYANSKIY, M. YU.

[Abstract] A diagram is shown of a directional diagram forming unit which makes it possible to form several independent scanning beams. It is made up of radiating elements with boosters, dividers for a number of channels, phase inverters, adders, and terminals corresponding to the number of beams. Terminal decoupling between divider and adder terminals and echos in circuits cause distortions in the directional diagram which are specific for this type of unit. These distortions were calculated accurately, but in a cumbersome manner, in an earlier study. This paper gives a simple approximate analysis of these distortions, introduces criteria for optimizing the components of the unit, and discusses methods of reducing distortions in the directional diagram. An estimate is made first of the level and position of parasitic beams. The unit is analyzed as a transmitting system, the terminals of the adders being considered the inputs, those between the dividers and boosters the outputs, and the multiterminal networks making up the unit being considered dividers. Distortions can be estimated with sufficient accuracy by taking only once-reflected waves into account in the case of low distortion factors for the multiterminal networks used in the unit and sufficiently great decoupling between the output terminals of the dividers. Formulas are derived for determining the level and direction of a parasitic beam formed as the result of wave reflection in a channel. The concept of the generalized reflection factor, in terms of power, is introduced in order to estimate distortions in the directional diagram of an antenna with a multichannel directional diagram forming unit. This factor is defined as the ratio of the power of a wave reflected from a multiterminal network with an arbitrary dissipation matrix to the power of the incident wave. To reduce distortions in a multichannel unit it is necessary to minimize the maximum values of the generalized factors for distortion from the outputs of the dividers used in the unit. Rectifiers

and attenuators can be added to the unit's circuitry if their reflection factors do not surpass those of the dividers. It is a good idea to include these devices in circuits connecting phase inverters and dividers. A formula is provided for making a statistical estimate of the level of parasitic beams. Figures 1; references 5: 4 Russian, 1 Western.

Certain Aspects of Computer Hard and Soft Ware;  
Control, Automation, and Machine Planning

USSR

UDC 53.085

INFORMATION DISPLAY DEVICE

Moscow PRIBORY I SISTEMY UPRAVLENIYA [Control Devices and Systems] in Russian  
No 7, Jul 77 p 42

VASILENKO, V. I., candidate in technical sciences, and SITNIKOV, M. V.,  
engineer

[Abstract] An information display device has been developed at the State Planning and Design and Scientific Research Institute for the Automation of Operations in the Coal Industry, Moscow. It constitutes an information matrix whose field area depends on the volume of information to be displayed, as well as on the number of inspected objects. It serves as a means of inspecting the state of individual objects and also, through a memory panel, the overall state of a system at a given instant of time. Its standardized components are assembled into a grid of 3x3 cells with a honeycomb structure. The cells contain either an indicator unit or a switching unit, all interchangeable, any dummy cell is plugged with a cap. The grid dimensions are 60x60x16mm, the overall dimensions of the device are 380x320x80 mm, and those of the memory panel are 2590x1690x250 mm. The device can display 160 signals on an information field 0.122 m<sup>2</sup> in area, the memory panel can display 159 signals on a field 4.38 m<sup>2</sup> in area. The power requirement is 100 W and 350 W respectively. Several arrangements of grids are possible, depending on the application. Figures 2; tables 1; references: 5 Russian.

CZECHOSLOVAKIA

A SEMICONDUCTOR ALPHANUMERICAL DISPLAY ELEMENT

Prague SDELOVACI TECHNIKA in Czech Vol 25, No 7, Jul 77 pp 245-249

CHMEL, JOSEF; VYBORNY, ZDENEK; WARAUS, JIRI

[Abstract] The LQ 600 alphanumerical display is produced by TESLA National Enterprise; it is a new type of semiconductor element designed primarily for computer terminals and small table-top minicomputers. It is also used for displaying written texts, signs, or numbers on a TV type screen for easy observance. It can be used with bipolar integrated circuits, and has all the characteristics of semiconductor equipment, such as small dimensions, high reliability, long life and resistance to shock. The LQ 600 display is equivalent to displays of the MAN2A type produced in the USA by Monsanto, and of the type TIL produced by Texas Instruments. It may also be used instead of the displays DL-57 LITRONIX and 746-0005 DIALIGHT. The mechanical resistance, electrical and optical parameters, resistance to corrosion and to mechanical abuse of the LQ 600 unit are discussed. Instructions for operation and assembly of the unit are given. The LQ 600 display can show  $2^{36}$  different signs. The generation of signs is based on a constant memory (capacity 2240 bytes). This memory is equivalent to the TMS 2500 type of Texas Instruments. Figures 16; tables 3; references 5: 1 Czech, 4 Western.

USSR

UDC 53.085

#### INDICATORS BASED ON MIRROR SEMISPHERE

Moscow PRIBORY I SISTEMY UPRAVLENIYA [Control Devices and Systems] in Russian No 6, 1977 pp 43-44

IVANOV, L. D., engineer, and ISHIN, S. I., candidate in technical sciences

[Abstract] Three indicators are described, the basis of all being a cylindrical body with a mirror convex semisphere inserted in it, which can be moved inside the cylinder along its central axis with the aid of an auxiliary mechanism. The first two of the indicating instruments are multiscale, and are intended for visual checking of the actual values with respect to each parameter separately, and the integral values of all combinations of parameters. The third instrument is a single-scale precision indicator with an extended scale. This makes it possible to economize space on the instrument panel with maintenance of a high precision of reading. Drawings are shown of the three indicators and their makeup is explained in detail. Experimental data are presented with respect to the time needed by an operator to take readings. Use of the instruments described can contribute to an increase of the efficiency of checking and control systems. However, in each specific system it is necessary to take into account the nature and number of controlled parameters, the precision required and the range of measurement, when these instruments are used. Figures 3; tables 1; references: 3 Russian.

USSR

UDC 531.74.084.2:62-525

#### COMPARATIVE ANALYSIS OF PNEUMATIC FLUID POSITION SENSORS

Moscow PRIBORY I SISTEMY UPRAVLENIYA [Control Devices and Systems] in Russian No 6, 1977 pp 47-49

MOROZOV, A. I., candidate in technical sciences

[Abstract] Contemporary types of pneumatic fluid position and object detection sensors are considered, as well as their use for automation of industrial processes. The schemes of the sensors and the technical characteristics of the individual models are shown in two tables. Three models (F76-11, F76-21 and 2F76-21) manufactured by the Moscow Experimental Plant for Pneumoapparatus and Pneumoautomatics are listed. The balance of the items are from the U.S., U.K. and Austria (one from Festo Pneumatics). Figures 2; tables 2; references 3: 2 Russian, 1 Western.

USSR

UDC 535.8:666.189.2

EIGHT-CHANNEL OPTICAL FIBER COMMUNICATION LINE BETWEEN ELECTRONIC COMPUTER UNITS

KVANTOVAYA ELEKTRONIKA [Quantum Electronics] in Russian 4 No 7, 77 pp  
1610-1613 manuscript received 21 Feb 77

ALYAB'YEV, B. V., BASOV, N. G., ZARETSKIY, A. A., KARTSEV, M. A., KLIMOV, I. I., KURNOSOV, V. D., MATSVEYKO, A. A., MOROZOV, V. N., POPOV, YU. M., SATTAROV, D. K., SAFIULINA, S. S., SEMENOV, A. S., SERGEYEV, A. B., STEL'MAKH, M. F., SHIDLOVSKIY, R. P., and YASHUMOV, I. V.

[Abstract] The possibility of using fiber communication lines for computer technology is considered. The principal characteristics are described of an experimental 8-channel optical communication line for use between electronic computers. During development of the model, maximum use was made of standard elements and the time diagram of operation of the computer was taken into account. The communication line operates at a clock frequency of 1 MHz, and with a multiplex factor of two it is possible to transmit a 16-digit number. Figures 4; references 3: 2 Russian, 1 Western.

USSR

UDC 621.311.6:621.382.81

VOLTAGE SUPPLIES BASED ON MICROCIRCUITS FOR MEASURING AND INFORMATION PROCESSING SYSTEMS

Moscow PRIBORY I SISTEMY UPRAVLENIYA [Control Devices and Systems] in Russian No 7, Jul 77 pp 32-34

BAKONIN, YE. V., engineer

[Abstract] Miniaturization of stabilized voltage supplies for autonomous measuring and information processing systems, with a higher reliability and at a lower cost, is possible only by the use of the chopping method of voltage regulation with general-purpose and special-purpose microcircuit components. Such systems usually consist of a primary source of energy with a fluctuating output, whether dry cells or a storage battery, and a second stage: low voltage for integrated-circuit devices and high voltage for digital-readout devices. A series of such voltage supplies has been developed for operation with primary voltages  $-27^{+7}_{-4}$  V at ambient temperatures from  $-10$  to  $+50^{\circ}\text{C}$ . One such unit, a centralized voltage supply, combines a stage whose output resistance depends on the inverter-transformer and the rectifier-filter parameters with a stage whose output resistance is made low for high-current duty. Its general structural diagram is shown as well as

its electrical circuit designed for an output voltage of +4 V over the 0-1.25 A range of load current, with two extra outputs (+16 V for 0-0.16 A and -16 V for 0-0.16 A). Basic performance data for this unit and others in the series are tabulated. Figures 3; tables 1; references: 3 Russian.

USSR

UDC 621.372.061

#### ANALYSIS OF NOISE CHARACTERISTICS OF LINEAR CIRCUITS BY THE SUBCIRCUIT METHOD

Kiev IZV. VUZ:RADIOELEKTRONIKA [Bulletin of Higher Educational Institutions: Radio Electronics] in Russian Vol 20, No 6, Jun 77 pp 113-116 manuscript received 20 Oct 75; after revision, 27 May 76

AKOPYANTS, KH. G., and ZLYDINA, L. M.

[Abstract] During machine analysis of electronic circuits, use of the method of subcircuits makes it possible to decrease the order of the matrix of the circuit, and, consequently, to reduce the calculation time. Generalized algorithms for analysis of noise parameters of linear circuits by the method of subcircuits are shown in previous works by Kh. G. Akopyants and by Akopyants and L. M. Zlydina, where it is also shown that arbitrary sections of the circuit with correlated and noncorrelated noise sources can be chosen. In the present short communication the theoretical principles of construction of algorithms for analysis of the noise parameters of linear circuits are considered, as well as their sensitivity, for the case when the source of a noisy current is noncorrelated. The relations developed can be used for machine analysis. They are suitable for analysis of circuits of arbitrary configuration and are easily realized on common algorithmic languages of the ALGOL and FORTRAN type. Tables 1; references: 3 Russian.



## BIPOLAR SEMICONDUCTOR MEMORY AND ITS TIME PARAMETERS

Prague SLABOPROUDY OBZOR [Weak Current Review] in Czech Vol 38, No 8, Aug 77  
pp 364-373

PECHOUCEK, MIROSLAV; Computer Research Institute, Prague

[Abstract] The tolerance analysis of delays in a semiconductor memory using SN 7489 integrated circuits showed that the use of a recording decoder with a single byte matrix for storage of parity bytes offers an optimum arrangement from the aspect of both the equipment costs and of the speed of operation. Securing of the address and of the input and output data by more than one parity byte increases the probability of detection of a multiple error, but does not increase the speed of operation when the control circuits use the fast SN74S circuits. This applies also to memories with other memory circuits with different capacities. A control of output data in a subsequent operational cycle increases the maximum speed of operation by some 20 percent, but it has the disadvantage of making the location of an error more difficult. When the single type organization in the matrix of parity bytes is used, the advantage of the higher operational speed of such a control is lost. In the tolerance analysis we used the method of the worst possible case, which means that for individual circuits we use either the longest or the shortest delay guaranteed by its manufacturer. The calculation of time parameters is conducted with an accuracy of one nsec which may be excessively pessimistic. The parameters calculated in this way for the start and width of time pulses should be rounded off to the nearest five or ten nseconds. The accuracy of calculations using typical values for delays in individual circuits to which an estimated time safety value is added may prove unsatisfactory. Unexpected errors caused by insufficient safety used in an individual parameter are the most difficult to detect in numerical systems, and correcting the errors is very burdensome. Figures 11; tables 7; references 4: 3 Czech, 1 Western.

## MULTIDIMENSIONAL MODELS OF BIPOLAR TRANSISTORS [SURVEY]

Kiev IZV. VUZ:RADIOELEKTRONIKA [Bulletin of Higher Educational Institutions: Radio Electronics] in Russian Vol 20, No 6, Jun 77 pp 7-18 manuscript received 26 Jul 76; after revision, 7 Dec 76

MARIN, S. V., TIKHOMIROVA, YE. M. and FROLKIN, V. T.

[Abstract] The paper surveys the state of development of multidimensional models of bipolar transistors for machine design of integrated circuits. The necessity for development of the multidimensional models is caused by the fact that the one-dimensional models of transistors heretofore used in the practice of machine design of electron circuits do not make it possible to solve problems of modeling with the necessary precision. In addition, the stages of machine design connected with an analysis of electrical processes prove not to be as efficient as those expected with the use of contemporary computing techniques. As is shown in the literature, at present two promising courses of development of multidimensional models of transistors have been established. They differ in the method of representation of the structure during consideration of internal physical processes. The first (sectional models) uses a representation of a transistor structure in the form of a combination of homogeneous regions. The second (numerical-coordinate models) considers the transistor structure as a unified whole. The general principles of these methods are discussed in the present work, and a comparative analysis is made on the basis of the survey conducted. It is concluded that one of the most promising ways of development of multidimensional models of a transistor is the method of creation of numerical-coordinate models. It is significant that in this method it is possible in principle to model not only an individual transistor but also some arbitrary cross section or volume of a semiconductor integrated circuit. Figures 1; references 46: 10 Russian, 36 Western.

## NUMERICAL-COORDINATE MODEL OF SEMICONDUCTOR STRUCTURES

Kiev IZV.VUZ:RADIOELEKTRONIKA [Bulletin of Higher Education Institutions: Radio Electronics] in Russian Vol 20, No 6, Jun 77 pp 100-102 manuscript received 7 Dec 76

MARIN, S. V.

[Abstract] As shown in the literature, in order to create a digital model of any semiconductor device, mathematical models are used, based on

fundamental physical equations in combination with various additional relations which describe the behavior of carriers and the processes taking place in semiconductor structures. During development of three-dimensional numerical-coordinate models it is possible to employ several methods of approximation of fundamental physical equations (or their modification) with boundary conditions taken into account: with the use of a three-dimensional spatial network and two-dimensional network in the YOZ plane of the structure of the device, and with the use for a common solution of a one-dimensional model for the normal component of the current (along the X-axis), and finally, with the use of a two-dimensional network in the XOZ plane of the structure with subsequent integration with respect to the surface of the contacts in the XOZ plane for locating the currents of the device. The last of the methods is the most promising, making it possible to carry out consideration of an arbitrary cross section or volume of a semiconductor integrated structure. The present short communication considers realization of one problem of modeling multidimensional processes in a semiconductor structure containing one transistor, which can be considered the initial stage of solution of the overall problem mentioned above. Figures 1; references: 4 Russian.

USSR

UDC 621.382.001.2

#### DIFFERENCE MODEL OF DISTRIBUTED BIFILAR LINE

Kiev IZV.VUZ:RADIOELEKTRONIKA [Bulletin of Higher Educational Institutions: Radio Electronics] in Russian Vol 20, No 6, Jun 77 pp 31-38 manuscript received 7 Dec 76

KOGAN, V. L.

[Abstract] One of the problems of automatization of the design of devices for the microwave band and high-speed switching devices is the creation of mathematical models of homogeneous and nonhomogeneous bifilar lines suitable for an analysis in the time and frequency regions. In the present work a difference model of a distributed bifilar line is proposed which has the potentiality for calculating transient processes with its assistance, not only in linear but nonlinear circuits which contain distributed lines. The difference model is based on a numerical solution of differential equations in partial derivatives which described the distributed line. Relationships are presented which make it possible to present the difference model in the form of the matrix equation of a quadripole. The method of construction of the difference model considered is universal in the sense that it does not impose limitations on the nature of the law of change of the linear parameters of nonhomogeneous lines. The precision of modelling is determined by the number of subdivision points  $M$  with respect to the length of

the line and the value of the integration step  $\Delta t$ , and consequently, can be arbitrarily high. Expenditures of machine time on calculations with respect to the proposed model are proportional to the number of subdivision points  $M$ , which gives a considerable gain as compared with modelling of distributed lines by a finite number of units with lumped elements. Figures 2; references: 8 Russian.

USSR

UDC 621.385.832:681.3.058

#### A CONTROLLED FUNCTION CONVERTER USING A POLYTRON

Moscow PRIBORY I SISTEMY UPRAVLENIYA [Control Devices and Systems] in Russian No 7, Jul 77 pp 31-32

GERCHIKOVA, G. V., KISELEV, N. V. and ZELIKMAN, M. A., candidates in technical sciences

[Abstract] The polytron is an electron-beam vacuum device for function conversion of signals. It operates on the principle of an electron beam controlled by the electrostatic field set up by a set of function plates. The trajectory of the electron beam in two orthogonal planes is determined by both the voltage across the pair of horizontal-deflection plates and the potential distribution over ten pairs of function plates. The conversion characteristic of such a device, derived on the basis of linear voltage-current and deflection-sweep relations under quasi-steady conditions in the electron beam, serves as both performance and design criterion. Figures 3; references: 5 Russian.

USSR

UDC 681.3.001:621.382

#### EXPERIENCE IN DEVELOPING AND USING MICROPROCESSORS (REVIEW)

Moscow PRIBORY I SISTEMY UPRAVLENIYA [Control Devices and Systems] in Russian No 8, 1977 pp 18-21

GLAZOV, G. YA., DRIZOVSKIY, L. M., and KORENNOV, YE. F., engineers

[Abstract] Microprocessors have become a fashionable topic of journals and new reports are received every week regarding new applications for them. This article is devoted to summarizing and analyzing information on microprocessors and appears in the "Foreign Technology" section of this journal.

A definition is given of the term and the principle of operation of a microprocessor is described, with reference to its usual accompanying components. It is distinguished from traditional processors by the strict sequence with which it performs operations (its major shortcoming and reason for comparatively low speed). A diagram is given of a typical system containing a microprocessor. The capability of expanding this system by adding components and of building systems employing several microprocessors is discussed. The basic system consists of the microprocessor, which processes data according to a program, a read-only memory unit (PZU) which stores instructions issued by the microprocessor, along with constants, a random-access memory unit for storing changing data and the results of processing it, and a data input-output unit. The PZU, which determines the special application of the microprocessor to a large extent, is discussed in detail. Dynamic and static types of ZU's [random-access memory units] are discussed. Methods of controlling interfaces and the effect of these methods on the characteristics of systems are dealt with. The three most commonly used methods of direct address are compared, with reference to maximum data transmission rate, state of the microprocessor in direct address, and comparative complexity of design. The influence of word length on the execution rate is discussed. One of the main obstacles to wider application of microprocessors is the high cost of programming, as compared with hardware costs. The present trend is to make it feasible for microprocessors to process programs written in high-level language (Fortran and PL), but the lack of compilers for translating a program from a high-level language to machine language has been an impediment here. High-level languages would reduce programming costs. Compilers now available are discussed, such as Intel's (USA) and GEC's (Great Britain), the first for PL/M and the second for Coral-66 for the Intel-8080 microprocessor. Integrated Computer Systems' (USA) course on the advantages and disadvantages of different types of programming is discussed. A table is presented, comparing the main technologies used to manufacture microprocessors, the two main methods being MOS [metal-oxide semiconductor] technology and bipolar technology. The latter makes higher speed possible, although it is more expensive. The advantages of n-channel (n-MOS) technology over p-MOS are listed. Features of microprocessors utilizing Schottky diodes are discussed. The main features of microprocessors manufactured with the use of different technologies are compared in tabular form. The article is to be continued in PRIBORY I SISTEMY UPRAVLENIYE, No 9, Sep 77. Figures 2; tables 2; references 11: 2 Russian, 9 Western.

USSR

UDC 681.3:621.372.061

ANALYSIS OF PROGRAM OF ELECTRONIC CIRCUITS PARM FOR SINGLE SERIES ELECTRONIC COMPUTER

Kiev IZV.VUZ:RADIOELEKTRONIKA [Bulletin of Higher Educational Institutions: Radio Electronics] in Russian Vol 20, No 6, Jun 77 pp 119-120 manuscript received 14 Dec 76

TRUDONOSHIN, V. A., PIVOVAROVA, N. V., and PODGURSKIY, V. G.

[Abstract] The development of mathematical security for systems of automatized design on the base of a single series electronic computer is a pressing problem in machine design of electronic circuits. The present work is concerned with a Program of Analysis with the aid of Thinned-Out Matrices (PARM), intended for analysis of static states and transient processes in electronic circuits. The PARM program is basically written in ASSEMBLER language for a single series electronic computer. A number of circuits of the TTL and TLES type were checked with the aid of PARM. The expenditure of machine time of the YeS-120 electronic computer amounted to 20-30 minutes. The number of iterations, taking into account a calculation of the static state (as a transient process from turn on of the power supply), was within the limits of 2,000. The local precision of integration was not below 10 mV. References: 4 Russian.

USSR

UDC 681.3:621.372.061

AUTOMATIZED SYSTEM OF ANALYSIS OF OUTPUT PARAMETERS OF SWITCHING CIRCUITS (ASVP-1)

Kiev IZV.VUZ:RADIOELEKTRONIKA [Bulletin of Higher Educational Institutions: Radio Electronics] in Russian Vol 20, No 6, Jun 77 pp 85-89 manuscript received 25 Jun 76

FROLKIN, V. T., IL'IN, V. N. and SIDNEV, S. S.

[Abstract] Requirements are established for the structure of a unit for automatized analysis of the qualitative indices of electronic circuits. On the basis of these requirements, the three-level structure of a system of analysis of the parameters of a switching circuit, the ASVP-1, was selected. A brief description of its construction is presented, including subprograms of calculation of the output parameter, the control program and a description of the language assigned for the analysis. In an appendix to the paper, a practical example is presented of the realization of a control program. Figures 5; references: 5 Russian.

## CALCULATION OF POWER RESONANT AMPLIFIERS WITH THE USE OF AN ELECTRONIC DIGITAL COMPUTER

Kiev IZV.VUZ:RADIOELEKTRONIKA [Bulletin of Higher Educational Institutions: Radio Electronics] in Russian Vol 20, No 6, Jun 77 pp 103-104 manuscript received 27 Oct 76

EBERT, YA., and SHARANETS, V.

[Abstract] This short communication was obtained from the Institute of Radioelectronics of the Warsaw Polytechnic, Poland. As shown in the literature, during calculation of power amplifiers and generators, basic difficulties are connected with modelling of the nonlinear properties of amplifier components (tubes or transistors). In the frequency range where it is possible to neglect the change of the reactive parameters of such components, their nonlinear properties are described by static volt-ampere characteristics. It is possible to approximate the static characteristics of tubes or transistors with the aid of power polynomials. A method of approximation is described in the present short communication which can also be used for machine calculation of resonance amplifiers. The procedure for doing so is explained. References: 4 Polish.

## USSR

## LOCALIZATION OF MALFUNCTIONS OF "URAL-14" ELECTRONIC COMPUTER

Moscow AVTOMATIKA, TELEMEXHANIKA I SVYAZ' [Automatics, Telemechanics and Communications] in Russian No 8, 1977 pp 28-29

KRIVCHENKO, YU. D., senior engineer, Computing Center of Gor'kiy Road; and MISEVICH, V. N., department chief of division, Candidate in Technical Sciences

[Abstract] A test of the operation of the "Ural-14" digital computer on the Gor'kiy Road showed that the cause of breakdowns is primarily hidden self-removing defects in units and assembly. The rate of occurrence of malfunctions in the case of preventive conditions amounts initially to one error for several hundreds of hours of operation of the electronic computer. Subsequently, it increases to one error for several tens or units of hours. With preventive conditions, it is generally not possible to increase the rate of malfunctions still more. It is fairly difficult to detect malfunctions in the "Ural-14" because of the absence of the appropriate equipment and mathematical provisions. Consequently, such an

operation is accomplished on the basis of accumulated data with reference to the nature of the malfunction, and, naturally, much time is expended on the elimination of specific inaccuracies. In order to accelerate localization of malfunctions, a device is proposed, the principles of operation of which are described. A functional diagram and a photograph of the overall device are presented. At present the device is operating successfully at the Computing Center of the Gor'kiy Road. Figures 2.



USSR

UDC 621.317:621.397.13]:037.37

DIGITAL MEASURER OF VIDEO SIGNAL LEVEL

Moscow TEKHNIKA KINO I TELEVEDENIYA [Technology of Motion Pictures and Television] in Russian No 8, Aug 77 pp 48-50

BORODITSKIY, F. S., and POLUSHKINA, A. F.

[Abstract] A new type of digital measuring device is considered--digital measurers of the level of a TV signal. The parameters which characterize the quality of this form of measurer are determined, and norm settings and verification of these characteristics are developed. During measurement of the level of real (affected by noise) and test TV signals, operation is possible both in the case of statistical processing of the measurement results, and without it. The principal technical characteristics and an overall photograph of the device are presented. The measurer had a small error, a large input resistance and a substantial long-duration stability. Figures 3; references: 8 Russian.

USSR

UDC 621.397.13

TRANSMITTING TELEVISION NETWORK WITH CENTRALIZED REMOTE CONTROL AND MONITORING

Moscow ELEKTROSVYAZ' [Electric Communication] in Russian No 7, Jul 77 pp 1-6 manuscript received 27 Jan 77

DERYUGIN, N. G.

[Abstract] The alternative construction and organization of operation of an automated television transmitting network (APS) with centralized remote control and monitoring is considered. The proposed construction is preliminary, subject to detailed technical-economical study and experimental checking at experimental sections of the network. The principal requirements on systems of control, signalization and monitoring of an automated television station are presented. A possible variant of a system of telecontrol--tele-signalization for operation in the APS is described. It is concluded that the proposed APS makes it possible to solve problems concerned with assuring that television stations and transmitters are operated by trained engineer-technical personnel (because of a reduction of the labor intensity of their maintenance) with contemporary control and measuring equipment, as well as to accomplish centralized technical control of the operation of transmitting facilities. It is possible to use simple electronic computers in the APS for automation of certain processes of control and monitoring. Figures 3; references: 3 Russian.

USSR

UDC 621.397.13:778

#### CONSTRUCTION OF AN ORHOSTEREOSCOPIC TELEVISION SYSTEM

Moscow TEKHNICA KINO I TELEVIDENIYA [Technology of Motion Pictures and Television] in Russian No 6, Jun 77 pp 62-66

MAMCHEV, G. V., Novosibirsk Electrical Engineering Institute of Communications

[Abstract] Stereo television systems are used both for measurement purposes and for complexes to control various moving objects. An important requirement on systems of this kind is a geometrically correct, i.e. orthostereoscopic, reproduction of a stereo model of the object of observation. The author defines the conditions of orthostereoscopic reproduction of TV images and gives design particulars of an orthostereoscopic system. Formulas are given for determining the main characteristics of the individual components in such a system. It is shown that to avoid geometric distortion in reproduction it is necessary to adjust the position of the transmitting cameras, the stereo screen and also to adjust the focal length of the camera lenses depending on the operator's position in front of the stereo screen. The orthostereoscopic system reproduces the look-around effect in both the horizontal and vertical directions, which enables the operator to get all possible information on the object of observation. The main parameters of the orthostereoscopic TV system as an automatic control system are static accuracy and the speed of adjustment of individual components. Figures 3; references: 11 Russian.

USSR

UDC 621.397.61

#### IMAGE SENSORS BASED ON CHARGE-COUPLED DEVICES

Moscow TEKHNICA KINO I TELEVIDENIYA [Technology of Motion Pictures and Television] in Russian No 8, Aug 77 pp 51-57

FRIDMAN, A. N., and YAKOVLEV, S. B.

[Abstract] A survey is made of the development of image sensors [datchik] based on charge-coupled devices (DI PZS). The principles of operation of such sensors involve transformation of the distribution of brightness of an object projected on the surface of the device, the distribution of minority charge carriers in the device, storage of them in especially created local zones (potential wells) and subsequent shifting of the charges into an output system for transformation into a video signal. The paper considers the physics of operation of DI PZS; organization of single line and matrix DI PZS; the characteristics of DI PZS; achievement and creation of DI PZS; and TV cameras based on DI PZS and their parameters. Because of its many

advantages and the complete absence of inertia it is possible to use the DI PZS in many areas of application. Examples of these areas are use of the DR PZS in cosmic investigations and during detection of elementary particles. In industry the DI PZS makes it possible to create small-sized and reliable devices for monitoring and control of technological processes, and optical identification of symbols and shapes. It is possible that the matrix DI PZS can be used in the creation of cameras. It should be noted, however, that the most perfect contemporary DI PZS have not reached the level of the best television camera tubes with respect to sensitivity and resolution, and in addition their color sensitivity in the "dark blue" field is low. For their further refinement, an improvement of construction and technology is required. But, regardless of this, the DI PZS begins to play a dominating role during development of new types of television cameras. Figures 6; tables 3; references: 15 Western.

USSR/CZECHOSLOVAKIA

UDC 621.397.61

#### NEW ELEMENTS IN SYSTEMS FOR CONTROL OF TELEVISION TRANSMITTERS

Moscow ELEKTROSVYAZ' [Electric Communication] in Russian No 7, Jul 77  
pp 10-13 manuscript received 8 Dec 75

BEDNARZH, I., Czechoslovakian Socialized Republic

[Abstract] The practical use of digital integrated circuits and transistors in systems for control of television transmitters such as the "Zone-II" produced by "Tesla-Hloubetin" is described. The wide assortment of digital integrated circuits produced by the "Tesla-Rozhnov" enterprise makes it possible to manufacture transmitter control circuits of a high technical level. Type MN74 digital integrated TTL circuits produced by "Tesla-Rozhnov" are used, for example, during the solution of logical functions, which consist in practice of a combination of logical sums and products. Photographs are shown of the exterior of the television transmitter control block and two units which enter into the composition of the block. Figures 5; tables 2.

USSR

UDC 624.97:551.594.221.001.4

# LIGHTNING STRIKING THE OSTANKINSK TV BROADCASTING TOWER

Moscow ELEKTRICHESTVO [Electricity] in Russian No 8, 1977 pp 19-23  
manuscript received 25 Nov 76

GORIN, B. N., candidate in technical sciences, LEVITOV, V. I., dr in technical sciences, and SHKILEV, A. V., candidate in technical sciences. Power Engineering Institute imeni G. M. Krzhizhanovskyy

[Abstract] Some results are presented of multi-year investigations of lightning which were conducted at the 540-meter high Ostankinsk TV tower in Moscow. The characteristics of lightning striking the TV tower and the surface of the earth close to it are discussed. The fact that lightning struck the tower was established by the readings of discharge counters positioned directly on the TV tower, and by photographs of discharges obtained with the aid of automatic photorecorders. Photographic registrations were accomplished at two points located at distances of 385 and 550 meters from the TV tower at an angle of  $105^\circ$  from one another. The results are analyzed of oscillographic registration of the pulse currents of lightning striking the TV tower. These registrations had as their goal to establish the statistical parameters of the lightning current pulses and the peculiarities of their formation during lightning strikes of a very high installation. Figures 7; tables 3; references 10: 8 Russian, 2 Western.

USSR

UDC 771.531.2:621.317.75

# NEW PHOTOGRAPHIC PAPER FOR OSCILLOGRAPHY

Moscow PRIBORY I SISTEMY UPRAVLENIYA [Control Devices and Systems] in Russian No 8, 1977 pp 48-49

NOVAK, R. S., engineer, PETRUSHKINA, Z. L., candidate in technical sciences, SHAMSHEVA, T. I., and NEZHEL'SKIY, V. A., engineers

[Abstract] This article reports on the composition and characteristics of a new photographic paper, "Ostsillografnaya M3," which is being manufactured at the Pozitiv Photosensitive Materials Plant in Leningrad and the Kiev Photographic Paper Plant. This paper features a protective gelatin film for protection of the emulsion film from mechanical damage and good "tanning" of the light-sensitive film, making chemical photographic processing by machine possible. The new paper makes possible a faster recording rate and greater visual contrast than papers presently used. A fine-grained bromium-iodine-silver emulsion was developed, making it possible to reduce

the thickness of the emulsion layer when coating the paper. The fine granularity makes it possible to increase the optical density of the recording line, and the thin emulsion layer improves definition by increasing the sharpness of the recording line. Chemical and optical orthochromatic sensitizing were used to achieve a photosensitivity level of at least 600 units. Photosensitivity of the new paper is not worse than that of commercially manufactured papers. Comparative tests were made using an N115 beam-type oscillograph. Tables of results are given, showing grain size, photosensitivity, useful exposure range, and maximum optical density, as well as maximum recording rate and visual contrast, for the new paper and commercial paper. Tables 2.

USSR

UDC 778.533:534.83

#### VIBRATION-PROOF ISOLATION OF MOVIE CAMERA MECHANISMS

Moscow TEKNIKA KINO I TELEVIDENIYA [Technology of Motion Pictures and Television] in Russian No 8, Aug 77 pp 14-16

KORYAGIN, G. I.

[Abstract] A method of using vibration-proof isolation of movie camera mechanisms is described. The method was first used for calculation of vibration-proof isolation of the "Konvas-avtomat" movie camera in a prototype version, which gave positive results with respect to reduction of the noise level. However, because the camera has a ring mount and there is no rigid coupling in it of the objective-film, vibration-proof isolation of the mechanism from the exterior housing lead to unsteadiness of the image. In the "Arrifleks BL" camera, in which the film channel and the objective holder are fixed on one component (which guarantees to them rigidity of the system of objective-film), the problem of reducing the noise level is successfully solved. During the structural development of movie cameras, in addition to vibration-proof isolation of the mechanism from the exterior housing, it is also necessary to give consideration to the dynamic balancing of the mechanism. If this is neglected the decrease of noise will not be complete. Figures 1; references : 6 Russian.

## A UNIT FOR TIME-LAPSE MOTION PICTURE PHOTOGRAPHY

Moscow TEKHNKA KINO I TELEVIDENIYA [Technology of Motion Pictures and Television] in Russian No 6, Jun 77 pp 68-69

POMEL'TSEV, N. S., All-Union State Institute of Cinematography

[Abstract] A simple and reliable time-lapse motion picture device has been developed in the laboratory of special forms of photography of VGIK [All-Union State Institute of Cinematography]. Maximum use is made of standard components, and the auxiliary components are made in the form of separate modules. The device uses the K24m-5 single-frame electric motor, which can be combined with many Soviet cameras. To prevent overheating of the motor during long pauses, an MKU-48 relay in an updated modification (RA4 501 195) with pneumatic delay disconnects the motor 0.5 s after it is stopped. The operation of the disconnecting circuit is explained. The device also includes a pulse generator with pulse recurrence rate variable from 5 s to 1 minute. The required time interval can be set by a variable resistor. Figures 2.

USSR

UDC 523.164

STANDARD REFERENCE SOURCES FOR CALIBRATING RADIATION FLUXES AND DETERMINING  
ANTENNA PARAMETERS BY RADIO ASTRONOMY METHODS

Gor'kiy IZV.VUZ:RADIOFIZIKA [Bulletin of Higher Educational Institutions:  
Radiophysics] in Russian Vol 20, No 7, Jul 77 pp 969-981 manuscript  
received 28 Jan 76

ALTUNIN, V. I., IVANOV, V. P., and STANKEVICH, K. S., Scientific-Research  
Institute of Radiophysics

[Abstract] Accurate radio astronomy method of absolute measurements to determine the intensity of discrete sources are now being implemented, at centimeter and decimeter wavelengths, with antennas having small effective areas and, therefore, applicable only to large sources. Consequently, from over 30 published catalogues listing about 20,000 radio astronomy objects there have been selected four primary reference standards of radiation spectra (Cassiopeia-A for 25-200 MHz, Cassiopeia-A for 200-10,000 MHz, Cygnus-A for 6-20 GHz, Jupiter for 10-100 GHz) and four groups of secondary reference standards (for 25-200 MHz, 200-6,000 MHz, 6-10 GHz, and above 10 GHz, respectively) against which the antenna parameters and radiation flux measurements in either the northern or the southern hemisphere can be calibrated. Various scales of flux intensity are compared in terms of their different frequency ranges as well as their limitations with respect to the reference sources and the spectral characteristics of the latter. Figures 5; tables 7; references 42: 1 Russian, 41 Western.

Communications, Networks;  
Data Transmission

USSR

COMMUNICATION LINES VIA AMATEUR ARTIFICIAL EARTH SATELLITE

Moscow RADIO in Russian No 7, 1977 pp 20-21, 26

SHEAREV, A., candidate in technical sciences (UW3BJ)

[Abstract] This paper is an adjunct to one by V. Dobrozhanskiy in the same issue of RADIO, under the general heading "Radio Amateur Satellites." The present paper is concerned with problems of power for communication lines Earth--AES--Earth. A formula is derived which makes it possible by introducing specific data of communication lines and equipment parameters, to determine the necessary communication conditions and the power potential on the system as a whole. Antenna-feeder devices at the earth communication point are considered, and particular attention is given to the directional characteristics in the vertical plane with small angles to the horizon, and to the polarization characteristics. Drawings are presented of two vertical antennas (the dimensions correspond to the 28 MHz band), a spiral antenna, and a "wave channel" antenna with orthogonally positioned elements. The antennas are briefly discussed. Figures 4.

USSR

A RETRANSMITTER: HOW TO OPERATE VIA IT

Moscow RADIO in Russian No 7, 1977 pp 17-19

DOBROZHANSKIY, V., state prize winner, USSR

[Abstract] This paper is an adjunct to one by A. Shesarev in the same issue of RADIO, under the general heading "Radio-Amateur Satellites." In previous papers [RADIO, 1976, No 5, pp 24-25 and No 9, pp 13-14] all the advantages were shown of amateur retransmitters installed on artificial earth satellites (AES) with circular, close to polar orbits. The present work discusses the parameters involved in movement of the AES and the zone of radio visibility is determined. A chart is presented of the stereographic polar projection of the northern hemisphere which is used during determination of the necessary data. Figures 9, tables 2.



USSR

AMATEUR EQUIPMENT FOR ARTIFICIAL EARTH SATELLITE COMMUNICATION

Moscow RADIO in Russian No 8, 1977 pp 30-32

LABUTIN, L. (UA3Cr), master of sport, USSR

[Abstract] General requirements are presented which must be satisfied by equipment used by radio amateurs for communication via an artificial earth satellite, and which must be foreseen from the beginning by the designer. Details of the necessary receiving and transmitting equipment, and the antenna are discussed. A previous article (RADIO 1977, No 7, p 20) concerned with artificial earth satellite signals should be read in conjunction with work on the antenna. Figures 4.

USSR

UDC 621.315.21:621.317.611

MEASUREMENT OF ATTENUATION OF BALANCED CABLES IN THE FREQUENCY RANGE UP TO 140 MHZ

Moscow ELEKTROSVYAZ' [Electric Communication] in Russian No 7, Jul 77  
pp 28-30 manuscript received 28 Feb 77

KAMALYAGIN, V. I., and TSYM, A. YU.

[Abstract] One possibility for an increase of the carrying capacity of HF balanced cables is multiplexing them by equipment of secondary, tertiary and quarternary digital transmission systems. In connection with this, the electrical characteristics of balanced cables in the frequency range up to 140 MHz are investigated, and in so doing the most important and complex investigations are measurements of various attenuation factors. During the investigations the greatest effort was expended on the creation of a broad-band measuring balancing device. The choice of construction of a balancing device is described. In this connection a differential amplifier and three types of transformers are investigated. Measurements of attenuation of a balanced cable in the frequency range up to 100 MHz were performed with the use of transformers and instruments developed by Siemens. In the range above 100 MHz the SMV-7A2 selective receiver of the RFT [East German] firm was used. It is noted that the transformers developed with decreased leakage inductance make it possible to measure the attenuation of balanced cables in the frequency range up to 140 MHz with the aid of the available stock of devices with inputs (outputs) unbalanced relative to the earth. In addition, on the basis of transformers with a low leakage inductance, it is possible to create devices which couple circuits of balanced cables with regenerators (amplifiers). Figures 4; references: 4 Russian.

USSR

PIG DEVICE FOR MEASUREMENT OF THE DEPTH OF POSITION OF CABLES

Moscow ELEKTROSVYAZ' [Electric Communication] in Russian No 7, Jul 77 p 32

[Abstract] The article describes the PIG [expansion unknown] device developed by the Odessa Branch of the Central Design Office, Ministry of Communications, USSR, for cable search, and discrete measurement and continuous monitoring of cable communication facilities. The device include the PIG-PI selective receiver, the PIG-PS search system and the TON-2 head-type receiver. The PIG is operated together with Type GIS and GIS-M test signal generators. The advantages of the device over similar units are shown and technical data on the device are presented.

USSR

UDC 621.315.682:621.395.743

CHOICE OF PARAMETERS OF ELEMENTS OF THE CONNECTORS OF CABLE CORES OF URBAN TELEPHONE NETWORKS

Moscow ELEKTROSVYAZ' [Electric Communication] in Russian No 7, Jul 77 pp 20-23 manuscript received 7 Jan 77

OVSYANNIKOV, A. I.

[Abstract] The construction and design of the new multicore Type SMZh-10 connector is described. The unit, which was designed by the Specialized Design and Technical Bureau of Construction Technology [SSKTB] is intended for simultaneous splicing of tens of pairs of cable cores of urban telephone networks with a diameter from 0.32 to 0.5 mm, which have any kind of insulation. The unit makes it possible to lighten by three times the most time-consuming operating during assembly of multi-pair cables - the splice - and to increase the quality of attachment of the cores. The elements of the connector can also be applied in other cases of assembly, for example, during connection of the cores of an internal cable with equipment, cross-connection wires in distributor heads and the like, i.e., where soldering and screw terminals are now employed. Figures 6; tables 1; references: 4 Russian.

USSR

UDC 621.315.758.37

COMPREHENSIVE PROTECTION OF CABLES FROM CORROSION, LIGHTNING STROKES AND  
ELECTROMAGNETIC EFFECTS

Moscow ELEKTROSVYAZ' [Electric Communication] in Russian No 7, Jul 77 pp  
24-27 manuscript received 21 Jul 75

VERINA, Z. S., LUNEV, O. A., SOKOLOV, S. A., and KUZNETSEV, A. V.

[Abstract] The results are presented of investigations of methods of comprehensive protection from corrosion, lightning strokes and electromagnetic effects of cables in aluminum and steel corrugated sheathing with a polymer insulating coating. The efficiency of such methods is discussed, and a technical-economical analysis is made with respect to the estimated cost of comprehensive protection of cables under various conditions of operation, using a number of different forms of protection. Practical recommendations are made with respect to achievement of comprehensive protection. Figures 4; tables 2; references: 4 Russian.

## DISTRIBUTION OF RADIO AND TELEVISION SIGNALS BY COAXIAL CABLES

Prague SLABOPROUDY OBZOR [Weak Current Review] in Czech Vol 38, No 8, Aug 77  
pp 356-363

CESKY, MILAN; TESLA - A.S. POPOV Research Institute for Technology of  
Communications, Prague

[Abstract] The article is a continuation of a paper published in the July 1977 issue of SLABOPROUDY OBZOR. Television cables are the only way in which reception can be obtained in places where geographical conditions do not allow the usual reception methods. Large areas and many receiving sets can be serviced by cable transmission. The distances over which the cables can be used depend on the specific dampening and impedance homogeneity of the coaxial cable, the dynamic reach of the amplifier, the method used for compensation of the variations of the intensity level of the signal in the cable network and the frequency of this compensation operation. Cables servicing 230,000 subscribers and providing up to 47 channels of television in addition to several radio signals are now in operation. An integrated cable transmission system with a unified telecommunication network would best guarantee that full advantage will be taken of the possibilities of cable transmissions. Various networks may be interconnected by means of satellite relays. Distortions in the transmission in cables are caused by imperfections in manufacture of the cable and to chemical processes in the dielectric substance. The amplifiers should operate with high output voltages. The variations in the levels of the voltage limit the transmission distance of a given cable system. Figures 14; tables 2; references 10: 4 Czech, 6 Western.

USSR

UDC 656.25:621.315.2.002.7

ASSEMBLY OF MKPmAShp  $4 \times 4 \times 1.05 + 1 \times 2 \times 0.7 + 1 \times 0.7$

Moscow AVTOMATIKA, TELEMEXHANIKA I SVYAZ' [Automatics, Telemechanics and Communication] in Russian No 8, 1977 pp 11-13

LYUBIMOV, K. A., head of laboratory TsNII MPS [Central Scientific-Research Institute, Ministry of Railroads, USSR] Candidate in technical sciences; GAVRILYUK, V. V., senior scientific worker, Candidate in technical sciences; POPOV, B. V., senior instructor Kuybyshev Institute of Communications; and DUDKOVA, A. V., trainee-researcher TsNII MPS.

[Abstract] In order to increase the strength of cables, workers at the TsNII MPS [Central Scientific-Research Institute, Ministry of Railroads, USSR] developed the Mark MKPmAShp  $4 \times 4 \times 1.05 + 1 \times 2 \times 0.7 + 1 \times 0.7$  cable with monolithic construction of the cores of the quads (see AVTOMATIKA, TELEMEXHANIKA I SVYAZ', No 7, 1976). Because of this construction, in the case of various mechanical effects, the cable maintains a high electric strength of the insulation and stability of all parameters. The present work gives the characteristics of the mechanical strength of the cable, and the method of joining lengths of the cable is described with the aid of photographs. Figures 2; tables 1.

USSR

UDC 656.25:621.315.2.071.84

SERVICING OF CABLE COMMUNICATION LINES

Moscow AVTOMATIKA, TELEMEXHANIKA I SVYAZ' [Automatics, Telemechanics and Communications] in Russian No 8, 1977 pp 22-24

SHABOTENKO, V. I., chief, Signaling and Communication Service, Southwest Line; and MALKIMAN, V. M., senior engineer, Road Laboratory of Communications

[Abstract] Various activities are reported which have taken place during the past 5 years on the Southwest Road. During that time more than 500 km of two-cable main route has been built, by means of which the number of channels of both long-line and inter-road communication increased considerably, and a network for transmission of data for computation centers was organized. Communication personnel of the road improved operational servicing of the cable lines, and a number of progressive technological processes were introduced. Thus, during construction of the two-cable main routes a method developed by workers of the road, together with members of the Institute of Electric Arc Welding imeni Ye. O. Paton,

Academy of Sciences, USSR, was used for connecting the aluminum sheathing of the cables by the "explosion" method. In accordance with instructions of the range and subsequently also the road laboratory, twice a year an analysis and point evaluation is made of the technical condition of the main communication lines and the content of the cables under gage pressure. During the evaluation such indices are considered as the asymmetry of the resistance to the direct current of the cores in a pair, the resistance of the insulation of the cores for 1 km and the resistance of the cores of a two-wire circuit at an air temperature of + 20°C, and the quantity of response of AKOU measuring devices at NUP [uncontrolled repeater stations] and OUP [attended repeater stations]. Figures 2.

USSR

UDC 621.371.24

#### INVESTIGATION OF ASYMMETRICAL ANTENNAS ON TROPOSPHERIC RADIO LINES

Moscow ELEKTROSVYAZ' [Electric Communication] in Russian No 7, Jul 77 pp 42-43 manuscript received 28 Apr 76

TROITSKIY, V. N., and SHUR, A. A.

[Abstract] At present antennas with an axisymmetric directional diagram are used on communication radio links which employ long-distance tropospheric propagation of ultra-short waves. However, theoretical calculations in previous works by V. N. Troitskiy showed that asymmetric antennas have certain advantages in comparison with symmetrical. In order to test these calculations, investigations were conducted in December 1972 and April 1975 on test radio links -- two littoral paths in the Baltic Sea region with lengths of 224 and 426 km (equivalent length of paths, 200 and 426 km). One transmitter, operating at a wavelength of approximately 6 cm was used on these paths. It was found that, in comparison with symmetrical antennas, asymmetrical antennas -- the horizontal dimension of which is considerably larger than the vertical -- gave a gain in the signal level, particularly at low levels (which is important in practice), better protection from interference of land-based services, and create less interference themselves with an identical amplification factor. Figures 5; tables 2; references: 2 Russian.

## TRANSMISSION OF MICROWAVE-MODULATED RADIATION THROUGH FIBER LIGHT GUIDES

KVANTOVAYA ELEKTRONIKA [Quantum Electronics] in Russian 4, No 7, 1977 pp 1597-1600 manuscript received 7 Jan 77

NESTEROVA, Z. V., POPOV, YU. V., FEDULOV, V. M., SATTAROV, D. K., and FREYVERT, K. M.

[Abstract] The results are presented of investigations of the frequency characteristics of fiber light guides from the point of view of transmission of undistorted information. An experimental investigation of the nature of demodulation of optical radiation as a function of the length of the fiber light guide was conducted at a modulation frequency of approximately 810 MHz. A method of conversion of the modulation frequency in a photodetector served as the foundation of the investigation. The experimental equipment used involves the radiation of a LG-126 He-Ne laser, with  $\lambda = 0.63$  micrometer with a radiation power at the output of approximately 10 mW; and a light modulator. As the microwave photodetector, a photodetector was used, which consists of a combination of a photomultiplier with a microwave resonator. The microwave light modulator developed for this occasion functions on the basis of a linear electro-optical effect in a lithium niobat crystal. It is tuned in the 760-980 MHz frequency range and with the aid of a continuous microwave signal of approximately 1 W, a 25 percent modulation is assured. The single core multimode fiber light guide used in the investigation consists of pairs of VS58--B051 glass with a diameter of the core of 80 micrometer and optical losses of 700 db/km. Also investigated was the properties of a multimode fiber of TF1-860 glass with an exterior diameter of the envelope of 80 micrometer and a core diameter of 64 micrometer. Figures 4; references 4: 3 Russian, 1 Western.

CZECHOSLOVAKIA

TRANSMISSION OF SIGNALS THROUGH GLASS FIBERS

Prague SDELOVACI TECHNIKA in Czech Vol 25, No 7, Jul 77 pp 269-272

LOM, TOMAS, RNDr

[Abstract] Transmission of optical signals by means of glass fibers is characterized by a wide zone of transmission, low intensity of output, resistance to interference, absence of electrical charges or potentials, and saving of copper and of other scarce materials. The present article is based on a paper published in the Philips Technical Review [K. Mouthaan. Optical communications with glass fibres, PTR, Vol 36, No 7, 23 Dec 76] The light source for this transmission system may be a semiconductor diode or a semiconductor laser. The light should enter the glass fiber at a small angle of convergence or divergence. Transmission may be made to a distance of only a few miles; after this the shape of the image is regenerated and the signal amplified by a retranslation circuit. Transmission rates are of the order of 100 M bytes/sec. Velocity of the signal depends on the wavelength of the light and on the angle of entrance of the light into the glass fiber. The glass for the fibers should have a low absorption of visible light and be free of metal ions, mainly Fe and Cr, should have a homogeneous refractory index, and be free of irregularities in its structure. It is preferentially produced by chemical vapor deposition. The semiconductor laser radiation source should be made of pure P-type GaAs, with part of Ga replaced by Al. The heterotransitions are caused by the dual material GaAs/GaAlAs. Contacts within the laser are made of gold. The life of the lasers is 1000 to 5000 hours. The semiconductor laser is pulse-modulated at the rate of two giga-bytes/sec. The leading edge of the light pulse has a delay of one nanosec from the lead edge of the current impulse. The connection between the laser and the optical glass fiber must allow the correct angle of the light ray entrance into the fiber. The divergence of the light ray bundle is controlled by a spherical lens. Figures 11; references 9: 3 Czech, 6 Western.



USSR

UDC 681.7.068.4

# GAS-DIELECTRIC LIGHT GUIDE WITH AZIMUTHALLY ASYMMETRICAL CROSS SECTION

Moscow RADIOTEKHNIKA I ELEKTRONIKA [Radio Engineering and Electronics] in Russian Vol 22, No 8, Aug 77 pp 1545-1550 manuscript received 18 May 76

FOIGEL', A. V.

[Abstract] A gas-dielectric light guide is investigated, which is a dielectric microcapillary filled with gas, optically denser than the surrounding air. The interior and exterior boundaries of the microcapillary are a circumference with noncoinciding centers -- the most typical manifestation of azimuthal asymmetry. In the literature an investigation was made where the wall thickness in the case of certain values of the azimuth angle assumed a resonance value. The problem was solved in an approximate arrangement: a boundary condition of the impedance type was placed on the interior surface of the microcapillary wall. In the present work the case is considered where the wall thickness with respect to the perimeter nowhere takes a resonance value. A numerical solution of the problem is given in a rigorous electrodynamic arrangement, the results of which are compared with an approximate geometrical-optical solution. The dependence is shown of the thermal losses of the guided waves on the magnitude of the azimuthal asymmetry and other parameters. An approximate formula is found which makes it possible fairly simply to find the increase of losses in comparison with the symmetrical case, over a wide range of parameter changes. It is shown that geometrical optics describe an asymmetry which causes an increase of three times of the losses in comparison with the symmetrical case, with a precision on the order of 20 percent. The proximity of the geometrical-optical and the precise solution makes it possible to be confident that other types of azimuthal asymmetry of the wall thickness of a gas-dielectric light guide can also be described with satisfactory precision by geometrical optics. The author is grateful to B. Z. Katsenelenbaum for constant attention to the work and Yu. N. Kazantsev, T. A. Martynov, and V. V. Shevchenko for discussion of the results. Figures 4; references 4: 3 Russian, 1 Western.

USSR

UDC 621.391.7 + 621.378.3

# TRANSMISSION OF ANALOG SIGNALS THROUGH AN OPTICAL CHANNEL WITH POLARIZING PULSE MODULATION AND SUBCARRIER FREQUENCY MODULATION

Moscow RADIOTEKHNIKA [Radio Engineering] in Russian No 8, 1977 pp 70-72 manuscript received after completion, 25 May 76

ALISHEV, YA. V. and BERKUTOV, A. A.

[Abstract] This paper deals with an optical communications system which transmits analog signals and employs polarizing pulse modulation and an

FM (frequency-modulated) subcarrier. Information regarding the current value of the modulating signal is obtained from the deviation in the subcarrier frequency, making it possible to convert the FM subcarrier signal into a square oscillation, by which polarizing pulse modulation is accomplished with right and left rotation of the polarization plane at the transmitting end. Orthogonal signals are spatially separated in the receiver. The receiver consists of a quarter-wave plate which converts signals with right and left circular polarization into linearly polarized components, of a Wollaston prism which directs the vertical component to the first photodetector, and the horizontal to a second photodetector, and of a differential stage connected to the outputs of these photodetectors, where character-by-character separation of the alternating train of positive and negative pulses is performed. Laser emission, for example, has right circular polarization when transmitting a positive pulse, and left when transmitting a negative. A band filter for the subcarrier frequency follows the differential stage and is tuned to the first harmonic of the pulse train to be received, and finally there is a clipper with a frequency discriminator. Filtration of the linearly polarized background is also accomplished at the receiver's input, because it reacts to circularly polarized oscillations. A determination is made in this paper of the signal level in the subcarrier and of the signal-to-noise ratio relative to the power in the subcarrier, taking into account shot noise in the signal, as well as in the presence of shot noise in the background and of background (dark) current. A determination is made of the gain achieved with this method of transmitting signals, with an FM subcarrier and polarizing pulse modulation, over the method of linear flux modulation with an FM subcarrier. A determination is made of the output signal-to-noise ratio after frequency detection. Calculations made here demonstrate that this method of reception can even surpass in technical and economic ratings a unit which utilizes optical oscillator signal conversion. Figures 2; references: 6 Russian.

USSR

UDC 621.391.037.372

DETECTOR FOR OPTICAL BAND SIGNALS WITH STABILIZATION OF THE FALSE ALARM LEVEL

Moscow RADIOTEKHNIKA [Radio Engineering] in Russian No 8, 1977 pp 81-85  
manuscript received 21 May 76; after completion, 9 Sep 76

TOLPAREV, R. G. and POLYAKOV, V. A.

[Abstract] This paper presents an algorithm which makes it possible to fulfill the condition of holding the probability of a false alarm approximately equal to the predetermined probability throughout the entire time period of communication for normal operation of the system when detecting optical band signals, based on computing the noise threshold making fulfillment of this condition possible. A block diagram is shown of an adaptive

channel for forming an estimate of the unknown noise parameter which expresses the average number of noise photoelectrons during the period of operation, in order to implement the algorithm. The algorithm also requires computation of the noise threshold at each interval of time less than the noise correlation interval. The technic of polarizing selection is used to form an estimating channel which contains only a noise signal. The equipment used includes a laser directed at an electrooptical modulator, which receives the information to be transmitted. A quarter-wave plate and a Wollaston prism make up a space divider which receives the signal at the receiving end. The Wollaston prism is oriented so that only the reference background emission strikes one channel, and a mixture of background and useful signals the other. The first channel serves as the information channel, because only signals from the transmitter enter it, and the second channel is the channel for estimating the noise parameter and forming the threshold. The background emission is analyzed in this channel at the same solid angle at which the transmitter's signal is received. A table of expressions is given which makes it possible to determine, with different operating conditions for the system, the necessary amount of sampling (number of readings) for achieving the required level of adaptation of the system. It is possible, in addition, to determine the requirements for the length of the signal to be transmitted when the necessary amount of sampling and the range of variation in noise photoelectrons are known. Figures 2; tables 1; references 3: 2 Russian, 1 Western.

USSR

UDC 621.396.624

OPTIMUM DETECTION OF AN OPTICAL SIGNAL AGAINST A BACKGROUND OF SHOT NOISE  
BY THE DIRECT DETECTION METHOD

Moscow RADIOTEKHNIKA [Radio Engineering] in Russian No 8, 1977 pp 75-77  
manuscript received 27 Feb 76

GUS'KOV, N. A.

[Abstract] This paper is devoted to discussing detection of a strong optical signal against a background of shot noise in direct detection receivers with a single reading of the amplitude of the signal in the photodetector's output. The method of counting photoelectrons is not acceptable for a strong signal, although it is for a weak signal. The problem of reading the amplitude of the current in the photodetector's output had been solved previously only for the specific case of detection against a background of thermal noise. Reception of optical signals in the presence of strong additive noise of a shot nature is quite common. A theoretical determination is made of the structure and characteristics of an optimal receiver. Curves are shown for the probability of error as a function of the strength of the signal with different ratios of external noise to the signal for

three specific cases, for systems with passive and active pauses. It is concluded that the noise immunity of optical channels when measuring the amplitude of the channel's signal at the output of the photodetector, just as when counting photoelectrons, depends not only on the signal-to-noise ratio, but also on the strength of the signal itself. Similarly to the radio band, optical band systems with an active pause with noise much stronger than the signal make possible a twofold gain in signal strength as compared with systems with a passive pause. In all other instances there are considerable differences both in formulas for probability of error, and in the magnitude of the thresholds for resolving circuits. Figures 2; references: 3 Russian.

USSR

UDC 621.391.2

SPECIAL FEATURES OF DYNAMICS OF SYSTEM OF SYNCHRONIZATION OF PSEUDO-RANDOM SIGNALS, ALLOWING FOR TIME DELAY IN THE FEED-BACK CIRCUIT

Moscow RADIOTEKHNIKA I ELEKTRONIKA [Radio Engineering and Electronics] in Russian Vol 22, No 8, Aug 77 pp 1612-1618 manuscript received 11 May 76

SOLODOVA, YE. A., and SPIRIN, V. V.

[Abstract] At present, in various fields of science and technology, an increased interest is shown in control systems with aftereffect and delayed communications. Thus, for example, with the use in communications and control systems of wide-band pseudo-random signals, correlative processing (filtration) of such signals can be accomplished by a system of automatic control of the time delay of the signal. In the present paper, an account is given of the special features of the dynamics of a following circuit for delay of pseudo-random signals, which is described by a nonhomogeneous nonlinear differential equation with a retarding argument. Two types of low-frequency filters are investigated in the study: inertial filters and proportional-integrating filters, both in a control scheme. The capture band, the stability, and the time of entry into synchronism are evaluated as a function of the magnitude of the signal delay with respect to the feedback circuit. An analysis of the dependences presented shows that the overall regularity of behavior of systems with time delay with inertial filters in a control scheme is maintained. For a system with time delay with proportional-integrating filters, however, the possibility exists in addition, of varying the required characteristics of the system by a change of the filter parameters. Figures 10; references 6: 5 Russian, 1 Western.

USSR

UDC 621.376.2

#### OPTIMAL PROCESSING OF INTERFERING PULSED RADIO SIGNALS

Moscow RADIOTEKHNIKA [Radio Engineering] in Russian No 8, 1977 pp 3-10  
manuscript received 7 Jun 76

YARLYKOV, M. S., and RYABTSOV, A. L.

[Abstract] Hyperbolic radio navigation systems and other pulsed radio data transmission systems usually function under the effect of interfering radio signals formed by ground and sky waves. This article solves the problem of determining optimal algorithms for processing pulsed radio signals under these conditions and of computing errors in measuring messages transmitted, or, in this specific case, in navigation parameters. The problem is solved by using the methods of the Markov theory of optimal nonlinear filtration. A previous study had solved the problem of optimal processing by these methods of pulsed radio signals in the presence of only a ground or a sky wave. Equipment is synthesized here, along with an estimate of its noise immunity, for optimal processing of interfering pulsed radio signals for the case when the moments the direct and reflected signals arrive are unknown and the phases of the signals are random. The most useful signals are observed against a background of broadband interference approximated by stationary Gaussian white noise. The useful signal is defined as the result of interference between the direct signal and the reflected signal, which is delayed with respect to the direct signal for a random time interval. A block diagram of an optimal receiver is shown. This receiver employs quasi-coherent reception of direct and reflected radio signals. An equation is given for determining relative errors in filtration of moments of arrival of direct and reflected radio pulses. Errors are considerably greater under transient conditions than under steady-state conditions. Figures 3; references: 4 Russian.

USSR

UDC 621.376.32:621.396.662

#### AUTOMATIC TUNING OF THE RATE OF LINEAR FREQUENCY MODULATION

Moscow RADIOTEKHNIKA [Radio Engineering] in Russian No 8, 1977 pp 30-34  
manuscript received after completion, 1 Sep 76

BELOV, L. A. and KOCHMASOV, V. N.

[Abstract] It is possible to increase the linearity of frequency modulation by using a system for automatic phase tuning of linear frequency modulation (FAP LChM) with a reference delay line and a mixer. A block diagram of

this system is presented, which uses a tuned oscillator, a delay line, a sawtooth voltage generator, a mixer, amplifier, a phase detector at the amplifier's output, a standard-frequency generator hooked up to the phase detector at one input, and an error signal circuit at the output of the phase detector. A determination is made in this paper of the relationships between the parameters of this FAP LChM system, with which it is possible to tune the rate of linear frequency modulation to a predetermined value. A determination is also made of the optimal parameters of the error signal circuit making possible minimal deviations of the frequency from linearity during the modulation period. A study is made of steady-state and phase shift conditions. Parameters of the system are optimized. The influence of the phase detector's characteristics is discussed. The results of an experiment using a mockup of the system for operation in the decimeter wave band are given. Delay was accomplished here by using a coaxial cable. Oscillograms of voltage at the output of the phase detector are shown for several initial phase angles, without the FAP LChM system, with only an inertialess channel, and with inclusion of two error signal circuit channels, whereby the parameters of these error signal circuits were close to optimal. From these oscillograms it was possible to calculate deviations of phase from the initial value and deviations of the rate of linear frequency modulation from the predetermined level, by converting the former into the latter. It is concluded that the FAP LChM system discussed here makes it possible to stabilize the rate of linear frequency modulation with high accuracy. Figures 3; tables 1; references: 4 Russian.

USSR

UDC 621.391.2

# COMPLETE SUPPRESSION OF SIDE LOBES OF PERIODICAL CORRELATION FUNCTIONS OF PHASE-MANIPULATED SIGNALS

Moscow RADIOTEKHNIKA I ELEKTRONIKA [Radio Engineering and Electronics] in Russian Vol 22, No 8, Aug 77 pp 1600-1606 manuscript received 28 Apr 76

IPATOV, V. P.

[Abstract] The possibility is considered of suppression of the side lobes (remains) of periodic mutually correlative functions (PMCF) because of nonmatched linear processing of phase-manipulated signals. In particular, it is determined that in contrast to the case of aperiodic mutually correlative functions for many signals of the case considered, the form of linear processing discussed makes it possible to accomplish complete suppression of the side lobes of PMCF for any periodic phase-manipulated signals with linearly independent cyclic shifts. Thus, the possibility emerges of efficient employment for measurement of time in multibeam channels of signals with a periodic autocorrelation function, distant

from ideal. During selection of signals for the indicated purpose, the amount of reduction of the signal-to-noise ratio at the output of a filter for suppression of side lobes in comparison with a matched filter can be taken as a criterion. References 7: 6 Russian, 1 Western.

USSR

UDC 621.391.82

NOISE IMMUNITY OF TRANSMITTING DISCRETE INFORMATION WITH FREQUENCY ADAPTATION AND SPATIAL SEPARATION

Moscow RADIOTEKHNIKA [Radio Engineering] in Russian No 8, 1977 pp 67-70  
manuscript received after completion, 9 Apr 76

GUT, R. E.

[Abstract] Frequency-adaptation systems are beginning to be used in radio communications. In these systems transmission is performed only at the single frequency at which the signal-to-noise ratio is maximal. The receiving end makes a comparative evaluation of all frequencies set aside for communications, and the number of the best frequency is sent through a return channel to the transmitting end so that the transmitter might use this frequency. The quality of frequency channels can be evaluated on a continuous basis or discretely, using the results of receiving special periodically emitted probing signals sent by the transmitter. This paper examines the noise immunity of a system which would combine frequency adaptation with spatial separation during reception, one of the traditional methods of combating signal fading. This combination would be highly effective, because it makes it possible to transmit in each branch of separation at the frequency best for it. A single return channel is used to transmit auxiliary signals for the numbers of the best frequencies for each branch and the transmitter is controlled by sending information signals at the frequencies from which each optimum single for each individual branch of separation is chosen. An evaluation is made of the noise immunity of such a system using as an example coherent summation of separated signals with an incoherent resolving system described in an earlier study. Results are obtained for a hypothetical ideal system in which each branch at any moment of time can possess totally reliable information on the value of the channel's transmission coefficient at all frequencies. Periodically emitted probing signals make it possible for real systems to get this information. The results obtained here make it possible to evaluate the gain and noise immunity which can be achieved by means of adaptive frequency and spatial separation in systems using transmitters of identical power. Figures 2; references 9: 7 Russian, 2 Western.

## NOISE IMMUNITY OF INTEGRATED RECEPTION TAKING INTO ACCOUNT RANDOM INTERFERENCE BETWEEN CHARACTERS

Moscow RADIOTEKHNIKA [Radio Engineering] in Russian No 8, 1977 pp 45-53  
manuscript received 17 Jul 75; after completion, 2 Mar 77

MIKHAYLOV, A. V.

[Abstract] The difficulty in increasing the rate of transmission in modern data transmission systems is caused by the occurrence of random transient noise, whose power increases in direct proportion to the power of the signal received. The power of this noise increases abruptly with an increase in speed and with a specific passband for the system. When the speed approaches the Nyquist rate the power of the noise exceeds the power of the signal received and transmission of data is impossible. Even with high signal-to-noise ratios, with a speed of 3100 bauds and a passband of 3100 Hz, the probability of error in telephone channels with phase correctors is very great. Origin of this noise is associated with the restricted nature of the passband, so transient noise occurs in any data transmission system. This paper is devoted to making a determination of the probability density of transient noise with integrated reception and to a computation of certainty of reception in data transmission systems with high specific carrying capacity, taking into account random interference between characters. A simple method is suggested for determining the probability density of random transient noise in data transmission systems with channels having arbitrary amplitude-frequency and phase-frequency characteristics, with both integrated receivers and single-reference receivers. It is demonstrated that interference between characters reduces considerably the certainty of integrated reception. Transmission of data is impossible at speeds greater than  $1.43(2\Delta f)$  in systems with phase-manipulated or relatively phase-manipulated signals and integration reception as the result of interference between characters. When the speed is less than  $2\Delta f/1.5$  interference between characters does not influence the certainty of integrated reception in these systems. Reception by the single reference method is most immune to noise with speeds greater than  $2\Delta f/1.15$  bauds, and an integrated receiver is most immune to noise with speeds less than  $2\Delta f/1.15$  bauds, in data transmission systems with highly selective communications channels containing amplitude-frequency characteristic and phase-frequency characteristic correctors, taking random interference between characters into account. Figures 4; references: 19 Russian.



USSR

UDC 621.396.25

CORRELATION CHARACTERISTICS OF SPACE-DIVERSITY RECEPTION OF SHORT-WAVE SIGNALS IN THE AURORA BOREALIS ZONE

Moscow ELEKTROSVYAZ' [Electric Communication] in Russian No 7, Jul 77 pp 67-68 manuscript received 24 Nov 75

BLAGOVESHCHENSKIY, D. V., BUBIS, V. G., and KURCHENKO, YU. A.

[Abstract] The results are presented of an investigation of the correlation characteristics of space-diversity reception of short-wave signals in the aurora borealis zone. Experimental data for the investigation were obtained in the daytime during the period February to April 1975 from two single-hop sub-aurora radio links: Link 1--a southwestern route of 2800 km; and Link 2--a southeast route with a length of 2000 km. The receiving center of the links is found in the aurora borealis zone, and the source of the signals was two radio-stations of the State Time and Frequency Service. Three rod antennas were used for signal reception. The line of arrangement of the antennas was such that for Link 1, it lay in the plane of the arc of a large circle, and for Link 2, it was perpendicular to it. Figures 1; references: 3 Russian.

USSR

UDC 621.396.94

ESTIMATION OF PARAMETERS OF STOCHASTIC CHANNELS WITH RELATIVE METHODS OF TRANSMISSION

Moscow RADIOTEKHNICA [Radio Engineering] in Russian No 8, 1977 pp 72-75 manuscript received after completion, 17 Feb 77

LEVCHENKO, YU. G. and LOKHVITSKIY, M. S.

[Abstract] In this paper a determination is made of the optimum criterion for estimating the pulse response of a channel, in terms of the minimum r.m.s. error. Curves are obtained for the signal-to-noise ratio at the output of a unit for determining the channel's pulse response. It is found that it is necessary to use relative methods of transmission to eliminate reverse operation (error in sign) in separating the pulse response of the channel from the information signal. A block diagram is given for the unit used. A decision on the polarity of the information pulse transmitted is represented in the form of a positive or negative pulse entering the inputs of multipliers. Reference voltages from the input channel picked up from delay line taps are supplied to the other inputs of these multipliers. The result of multiplying is integrated by RC networks. The integration constant

is selected as a function of the rate of change in the channel's parameters. The operating rate of this unit must be considerably faster than the rate with which the channel's parameters change. Optimal algorithms for processing a signal passing through a channel with variable parameters require measuring the parameters of the channel. But a substantial simplification of equipment with but slight worsening of noise immunity can be achieved by dispensing with measurement of some channel parameters. The pulse response of the channel can be determined by using different types of pilot signals, and constantly new information on the status of the channel can be obtained by determining its pulse response via an information signal. The technic of minimizing errors is used here to solve the problem of differentiating the two signals while at the same time estimating the channel's pulse responses. Simplicity of algorithms is taken into account in selecting the optimum criterion. Instructing and self-instructing algorithms are considered; an asymptotically optimum algorithm is obtained for estimating the pulse response of the channel in both the instructing and self-instructing modes. The signal-to-noise ratio at the output of the signal separation unit is determined as a function of the length of the instructing sequence for different numbers of beams. Figures 2; references: 6 Russian.

USSR

UDC 656.259.12.625.162.6

# UNIFIED TECHNICAL REQUIREMENTS FOR TRACK CIRCUITS AND AUTOMATIC HIGHWAY CROSSING DEVICES

Moscow AVTOMATIKA, TELEMEXHANIKA I SVYAZ' [Automatics, Telemechanics and Communications] in Russian No 8, 1977 pp 13-15

KOTLYARENKO, N. F., head, Department of Automatics and Telemechanics KHIIT [Khar'kov Institute of Railroad Transportation Engineers imeni S. M. Kirov], Professor; BAZHENOV, A. I., chief, Technical Division of Main Administration of Signaling and Communication, MPS [Ministry of Railroads, USSR]; and TARASOV, B. N., chief, Division of STsB [Signaling, Centralization and Block Systems], Main Administration of Signaling and Communication, MPS

[Abstract] Economic integration of the Socialist countries has successfully developed in the field of railroad transport. One of the manifestations of such collaboration is the development of unified technical requirements for new track circuits and unified operations-technical requirements for automatic highway crossing devices. Development by the countries--People's Republic of Bulgaria; German Democratic Republic; Hungarian People's Republic; Polish People's Republic; Republic of Cuba; USSR; Socialist Republic of Rumania; and Czechoslovak Socialist Republic--is fulfilled in accordance with an agreement concluded among them according to the line of the SEV [Economical Mutual Council]. The leading organization with

respect to the development of unified technical requirements for new track circuits was the Center for Scientific-Research Activity of the State ECO Economical Association of the Ministry of Transportation of the People's Republic of Bulgaria, and with respect to the development of unified operations-technical requirements for automatic highway crossing devices--the Institute for Investigation and Technological Planning for Transportation, Ministry of Transportation and Communication, Socialist Republic of Rumania. The leading organizations in the USSR with respect to these problems were, respectively, the Khar'kov Institute of Railroad Transportation Engineers and the Institute "Giprotranssignalsvyaz'" [State Planning and Surveying Institute for the Planning of Signaling, Centralization, Communications and Radio in Railroad Transportation]. The new requirements were first coordinated at a conference of experts of the Socialist countries and subsequently unanimously adopted by a Council of the representatives of these countries. The various technical requirements are discussed in some detail.

USSR

UDC 681.3:621.395.345

ANALYSIS OF SYSTEMS OF OPERATION OF CONTROL DEVICES WITH A RECORDED PROGRAM FOR SWITCHING STATIONS

Moscow ELEKTROSVYAZ' [Electric Communications] in Russian No 7, Jul 77  
pp 44-48 manuscript received 5 May 76

BAKLANOV, YU. A., BURAVTSOV, V. M., VORONA, A. D., DELIMOV, V. E.,  
MISULOVIN, L. YA., TYSHKOVSKIY, A. K., GODUN, V. V., and BURE, G. V.

[Abstract] During development of control devices for integrated quasi-electronic communications systems, the problem has arisen of choosing a set of operations such that it will assure the greatest efficiency from the point of view of the volume of stored programs and the productivity of the control devices. In the present paper the effect is considered of the number of various operations realizable by the processors for these indices of efficiency. It is shown that the list of operations realizable in the control devices of a switching station is a compromise between minimizing the volume of stored programs and the productivity of the control devices. Consequently, it is advisable to limit to 20-25 the operations which have the greatest relative frequency. If, in order to assure compatibility with more developed systems of operation, the necessity arises for additional operations this can be realized by interpreting subprograms, practically without a reduction of the productivity of the control devices of the switching station and an increase of the stored programs. Figures 1; tables 3; references 5: 4 Russian, 1 Western.

USSR

# PROSPECTS FOR DEVELOPMENT OF A GENERAL-USE TELEGRAPH NETWORK

Moscow VESTNIK SVYAZI [Communications Bulletin] in Russian No 8, Aug 77  
pp 16-18

MARTSENITSEN, S. I., director of the Main Telegraph Administration of the USSR Ministry of Communications; ZHEVLYUK, K. S., division chief; PARIKOZHKA, I. A., division chief of KONIIS [Kiyev Branch of the Central Scientific Research Institute of Communications], and LUK'YANOV, V. V., laboratory director of KONIIS

[Abstract] Automation of the general-use telegraph network will be carried out according to a direct coupling (PS) system based on the channel switching (KK) method. Step-by-step selectors or crossbar couplers will form the basis of automatic stations of different capacity to serve as switching centers. More than 70 percent of telegraph centers are to be converted to the PS system. The present ATOL system, which is a semiautomatic system for handling telegrams which separates and forwards punched tape and utilizes unswitchable telegraph channels, will continue to exist even after introduction of the PS system is complete, in order to handle especially important telegrams through unswitchable channels. This combination PS-plus-ATOL system is constructed according to the radiating center principle, with separation of main and terminal centers. Some manual handling of telegraphs will continue after introduction of the PS system, especially for handling of excess traffic coming into centers. About eight percent of telegraph operators will be engaged in manual processing tasks. Maintenance of the ATOL system and the semiautomatic nature of the PS system, along with the situation of excess sensitivity to overloads characteristic of any channel switching system, create the need for further automation of production processes in the general-use network. This problem will be solved by using electronic message switching centers (TsKS's). Work is now under way to create these centers using a control computer complex based on YeS computers and the appropriate software. Feasibility and efficiency studies have resulted in suggestion of an optimum variant for the future general-use telegraph network which combines message switching (KS) with channel switching (KK). In the future network KS + KK message switching centers will be installed at telegraph centers with heavy traffic, i.e., chiefly at main communications centers. Each TsKS will be designed to handle all local, intraoblast, and intrazonal traffic for the zone to which it is assigned. This will make it possible to handle different types of excess telegraph traffic. A diagram is shown of the structure of the KS + KK network, which will consist of three telegraph zones with separate transit, or main, and terminal centers. Functioning of this network and interaction between the various centers is discussed in detail. TsKS's will also take care of semiautomatic indexing of telegrams by means of indexing operation points (RMIT's) installed in telegraph rooms at terminal centers in the network and connected to the TsKS by unswitchable telegraph channels. A key advantage of the KS + KK system is its capability of transmitting

priority telegrams first and of setting aside less urgent telegrams for later transmission to fit schedules. This is especially important in handling telegraph traffic between centers in different time zones. The KS + KK system will provide greater reliability than the PS system. Automatic bypassing between TsKS's, between KK stations, and between KK stations and a TsKS will be possible. Savings of equipment will result. The first message switching centers will be put into operation in 1979-80 and will replace ATOL communications equipment at large telegraph centers. Present work is being devoted heavily to conversion to the PS system. Figures 2.

USSR

SEARCH FOR NEW ACCOUNTING TECHNIC FOR STATE TELEPHONE SERVICE USERS FOR COMMUNICATIONS SERVICES RENDERED ON CREDIT

Moscow VESTNIK SVYAZI [Communications Bulletin] in Russian No 8, Aug 77  
pp 36-37

MAKSIMENKO, V. F., candidate in physicomathematical sciences, and  
NAZARCHUK, A. T., engineer, Republic Computing and Information Center of  
the Ministry of Communications, Ukrainian SSR

[Abstract] This article discusses a new method of billing home telephone accounts, developed by the Communications OASU [?Industry Automated Control System] Software Division of the Ukrainian SSR Ministry of Communications Computing and Information Center. The use of computer technology alone has not been able to solve the difficulties in handling customer accounts and inquiries occasioned by increasingly more extensive automation of long-distance telephone communications, in particular. A radical approach is suggested here. Presently bills are prepared by communications service accounting departments and sent to customers by mail. There is a great deal of inconsistency in billing periods, billing entries are manual or automatic, or a combination of both, and the information given on the bill may or may not contain an itemized list of calls made. An up-to-date address list of customers is necessary. A huge bookkeeping and accounting staff is necessary to maintain this system, much time is spent on updating and correcting records, and the postal system is overburdened. Customers pay their bills by mail. According to the new system customers would still pay by mail and individual customer accounts would be kept. But bills would not be sent. Without any notice from communications utilities, the customer would be obligated to call the utility at predetermined intervals and inquire about how much he owes and ask for a detailed listing. The utility would then give the telephone number and the amount of the bill for a certain number of months, or the number, amount due, and a breakdown of services rendered, including the date the call was made, the number called, and the city called. The first variant

is considered preferable for economic reasons. The customer would have a pad of forms, on which he would enter the information quoted to him by the utility's accounting department. This form would include a notice regarding the penalties to be imposed should the customer fail to call and inquire about his bill within the period specified. The customer would then tear off one copy of the form and include it with his payment. Three modifications of this system are detailed here. The first would use the present structure of the accounting department. Customers would be divided into groups by telephone number and/or billing period and would call into the accounting department accordingly. This approach is feasible in towns with relatively few private telephones where there are few restrictions on time spent to handle inquiries. The second approach is called "Semiautomatic Response." The customer calls in but does not speak to the accounting clerk. The customer's telephone number lights up on the clerk's panel and the clerk relays the information required. A diagram of the equipment needed for this system is shown. A trial run of this system in Kiyev, for handling home accounts for long-distance calls on credit, has resulted in a savings of 100,000 rubles per year. The third modification, called "Automatic Response," utilizes speech synthesizers, so communication both ways is totally by machine. A diagram of the equipment used for this system is also given, along with a variant freeing the computer from certain functions. Savings from introducing this system in Kiyev would amount to about 180,000 rubles per year, according to estimates. Figures 4.

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#### IMPROVING THE EFFICIENCY OF EXISTING MAIN LINES OF COMMUNICATION

Moscow VESTNIK SVYAZI [Communications Bulletin] in Russian No 6, Jun 77  
pp 17-19

BURENIN, V. A., MENG, V. A. and RAPOPORT, B. S., engineers, SMS-3 [?Nation-Wide Communications Network No 3]

[Abstract] The most economical way to improve the efficiency of existing long-distance communication lines is to increase the degree of multiplexing. On the SMS-3 this problem has been solved by expanding the transmission band of the linear channel of standard equipment K-60P-4 from 12-252 kHz to 12-552 kHz. This has increased the number of channels that can be handled by each type MKSB-60 1 x 4 x 1.2 cable pair, and provided an additional 45,000 channel-km of effective service per 375 km, saving 276,000 rubles. At the manned repeater stations and terminal amplifier points the frequency band is broken down into two sub-bands of 12-252 and 312-552 kHz, each provided with independent self-contained automatic control of the level of 60-channel groups. The lower frequency spectrum

is regulated with respect to three control frequencies, while the upper range is regulated with respect to a group frequency of 411.86 kHz, which is used as the control frequency of the line spectrum. Special measurements of the stability of the amplitude-frequency response over a 2-year period have shown that it is not necessary to modify the group AGC when the transmission band is expanded. Figures 4.

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#### MODULATION EQUIPMENT BASED ON SEMICONDUCTOR DEVICES

Moscow VESTNIK SVYAZI [Communications Bulletin] in Russian No 6, Jun 77  
pp 21-23

DUKHOV, V. V., MAYER, F. I., KIRILLOV, N. G., and MEDVEDEV, A. A., engineers,  
Republic Center for Radio Broadcasting, Radio Communications and Television  
of the Latvian SSR

[Abstract] Specialists at the Republic Center for Radio Broadcasting, Radio Communications and Television of the Latvian SSR have developed a video modulator based on semiconductor devices for improving the quality of color television transmission by stations of the TRSA-12/12 type. The modulator includes a unit for correcting the nonlinearity of the modulation characteristic of the transmitter on four variable levels of the TV signal, an effective control circuit for reconstructing the average component of the video signal, and a unit for correcting the group propagation time, as well as other components to improve the quality of color television program transmission. The characteristics of the modulator: rated peak-to-peak amplitude of the positive-polarity TV input signal 1 V, input impedance 75  $\Omega$ , maximum peak-to-peak amplitude of the negative-polarity TV output signal 50 V (when the bias voltage across the control grids of the tubes in the stage to be modulated is set in a range from -26 to -35 V on the quenching level). The nonuniformity of the amplitude-frequency characteristic does not exceed 0.5 dB from 0 to 7.5 MHz, pulse misalignment is no more than 1 percent at 50 Hz, and no more than 1.2 percent at 15,625 Hz, stability of the quenching level is with 0.5 percent, video signal-to-interference ratio is at least 45 dB. The modulator remains operable when the peak-to-peak amplitude of the input TV signal drops to 0.6 V with simultaneous superposition of background interference comprising 35 percent of the amplitude of the input signal. The working temperature range is from +5 to +55°C. The components and working principle of the device are explained. Figures 3.

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#### EFFECT OF TELEVISION SIGNAL RESHAPING DEVICES

Moscow VESTNIK SVYAZ [Communications Bulletin] in Russian No 6, Jun 77 pp 19-20

BARAMYKOV, A. I., chief, Radio Relay Line Shop, Ministry of Communications, Uzbek SSR

[Abstract] Improving the quality indices of intercity video channels is an important job for communications workers during the Tenth Five-Year Plan. Devices for reshaping (regenerating) a TV signal can be used to bring the characteristics of intercity video channels close to the parameters of a standard line. Requirements for such devices developed by the Republic Main-line Communications and Television Network of the Ministry of Communication of the Uzbek SSR, are considered. Among these requirements is the need for using complex circuits for discriminating and processing synchropulses in the regeneration devices. This reduces the phase-frequency distortions in the regenerated pulse structure of the TV signal. It is shown that the TV signal filtration band should be minimized. The reasons for failures of the regeneration devices are analyzed, and questions of automatic control are discussed. Figures 4.

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#### OPTIMUM TUNING PROCESS FOR TELEVISION STATIONS

Moscow VESTNIK SVYAZI [Communication Bulletin] in Russian No 8, Aug 77 pp 20-21

IVANOV, V. K., and MIRONOV, YU. S., chief engineers of NIIR [?Scientific Research Institute of Radio]

[Abstract] Specialists of NIIR in conjunction with personnel of enterprises of radio and television transmitting centers have been developing procedure charts for tuning a number of TV transmitters. A procedure has already been created for tuning the largest TV transmitter in the country, that of the "Yakor" radio station. This article deals with the principles underlying creation of procedure charts. These procedure charts outline the sequence of operations to be performed in tuning both the high-frequency channel and modulating equipment, as well as the transmitter as a whole. Procedures for preliminary adjustment, final adjustment, and tuning of equipment are covered. The charts are designed for tuning when performing start-up and debugging operations, after replacing tubes in the wideband high-frequency



channel and when performing repairs, as well as for adjusting the wideband channel when the transmitter's performance drops below the norm. The charts give the necessary instruments, materials, and tools needed, tell how often work is to be done, and give the sequence of operations to be performed. A distinctive feature of the technic employed is preliminary tuning of components of the wideband high-frequency channel, making it possible artificially to divide a complicated channel into components, to tune it first in sections, and then more quickly perform final tuning of all stages as a whole. Each chart is on a single compact sheet which can easily be separated from the set, making it easy to replace sheets as equipment designs are changed, and convenient to remove only the sheet covering the equipment which needs tuning. The sheets are detailed to the extent that personnel of mid-level qualifications can perform the procedures outlined. This represents an advance over the previous situation, whereby only highly skilled personnel could conduct tuning procedures. Procedure charts represent only the first step in introducing scientific organization of labor in tuning of TV and radio transmitters. The next step is to establish time limits for carrying out individual procedures. These will be established as advances in equipment are made and personnel become more highly qualified. The use of procedure charts at the "Yakor'" station has demonstrated their advantages: The time spent on tuning has been reduced twofold. The quality of work has improved. Work can now be performed by less skilled personnel than previously. Work is now being done in the area of outlining a technic for tuning the transmitter of the "Igla" station. The tuning specifications for the "Zona" TV and radio station transmitter require refinement and systematization.

Components and Circuit Elements Including  
Waveguides and Cavity Resonators

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CERAMIC CAPACITORS

Moscow RADIO in Russian No 6, Jun 77 pp 57-58

GELIKMAN, B. and NEZNAYKO, A.

[Abstract] This article is a reference sheet with specifications and construction diagrams of the K10-7V, K1017, K10-23 and K10U-5 ceramic capacitors. The K10-7V series are plates 0.18-0.22 mm thick with silvered electrodes. The capacitors are potted in epoxy. Rated voltage is 50 V. Working temperature range is from -60 to +155°C, and the capacitors can be used in AC, DC and pulsed-current circuits. Capacitance values range from 18 to 68,000 pF with tolerances of 10 and 20 percent. Guaranteed service life is 5000 hours. The rated voltage for K10-17 capacitors is 25 V, and for K10-23--16 V. These capacitors have values ranging from 2.2 pF to 1.5  $\mu$ F in tolerance groups of 5, 10 and 20 percent. They can be used in DC, AC and pulsed-current circuits at temperatures from -60 to +85°C. Resistance of the insulation is at least 10 M $\Omega$ . The K10U-5 series have high capacitance (maximum 2.2  $\mu$ F), and can be used only where the impedance and loss tangent are not important. The thickness of the capacitors does not exceed 5 mm. Diameter ranges from 7 to 19 mm, spacing between leads from 2.5 to 7.5 mm and weight from 0.5 to 2.5 g, depending on capacitance. The working temperature range is from -60 to +85°C. Rated voltages are from 3 to 50 V. Figures 4; tables 4.

USSR

UDC 519.24

OPTIMAL AND SUBOPTIMAL FILTERS FOR ESTIMATING CONTINUOUS PHASE COORDINATES

Moscow IZVESTIYA AKADEMII NAUK SSSR, TEKHNIЧЕСКАЯ KIBERNETIKA [Bulletin of the Academy of Sciences, USSR. Technical Cybernetics] in Russian No 4, Jul-Aug 77 pp 172-180 manuscript received 12 Nov 75

SHIROKOV, L. YE., Moscow

[Abstract] The problem of estimating the phase coordinates of an object optimally or suboptimally, according to the mean-squared-error criterion, is considered in terms of, respectively, optimal and suboptimal second-order filters. The state of the object is described by nonlinear differential equations and the tracking channel is assumed to be either continuous, discrete, or hybrid. The equations of such filters represent a special case of the solution to the filtration problem in dynamic systems. The application of the results is illustrated in determining the location of

a radiation source. The general theorem pertaining to observable and non-observable process is, moreover, extended here to the case where the coefficients in the equations describing the evolution of phase coordinates depend on continuous measurements. Figures 4; references 6: 5 Russian, 1 Western.

USSR

UDC 621.372.57.001.5

CONCERNING ONE METHOD OF FREQUENCY CORRECTION OF HIGH-Q ACTIVE FILTERS  
BASED ON EQUIVALENT TRANSFORMATIONS

Moscow RADIOTEKHNIKA I ELEKTRONIKA [Radio Engineering and Electronics] in  
Russian Vol 22, No 8, Aug 77 pp 1742-1744 manuscript received 26 Mar 76

PODOL'SKIY, L. Z.

[Abstract] In the literature, active filters based on integrators are described, which make it possible at considerably lower frequencies to achieve high (maximum for active RC circuits) values of the  $Q$  of the poles of a transfer function with low sensitivity, with an acceptable relation between the magnitudes of the time constants of the RC circuit and the individual controls of the natural frequency and  $Q$ . The principal shortcoming of these filters is the high dependence of  $Q$  on the operation frequency of the filter. It is also shown in the literature that with an increase of the working frequency,  $Q$  is increased as the result of the finiteness of the product of the amplification factor entering into the circuit of the operational voltage amplifier (OVA) at boundary frequency. Moreover, definite difficulties arise here in the case of miniaturization of filters in connection with the presence of a resistor in them, the magnitude of the resistance of which is proportional to the  $Q$ . Both of these shortcomings narrow down the possibility of using the filters in practice. The present short communication is concerned with facilitating a straightforward synthesis of equivalent transformations, also fulfilled on the basis of the integrators of the original circuit, which makes it possible to find an application with improved frequency properties. The equivalent transformations consist in switching of the exterior lead outs of the OVA and consequently do not require the introduction of any supplementary adjusting elements. Figures 2; references 3: 2 Russian, 1 Western.

## EMISSION OF CHARGED BUNCHES PASSING THROUGH A STACK OF DIELECTRIC PLATES IN A WAVEGUIDE

Gor'kiy IZV.VUZ:RADIOFIZIKA [Bulletin of Higher Educational Institutions: Radiophysics] in Russian Vol 20, No 6, 1977 pp 950-952 manuscript received 9 Feb 76

LAZIYEV, E. M., OKSUZYAN, G. G. and POGOSYAN, E. S.

[Abstract] This brief report gives the experimental results of a study of the characteristics of emission occurring when relativistic charged bunches of particles pass through a stack of dielectric plates in a waveguide. The parametric emission which occurs during axial passage of a charged particle through an infinite laminar medium filling a waveguide is quite familiar. The finite dimensions of this medium, as represented by a stack of dielectric plates, impose a number of characteristic features. The experimental apparatus, measurement technic, and parameters of the bunches of particles were described in an earlier paper by E. M. Laziyev and G. G. Oksuzyan. A linear accelerator with a beam power of about 50 MeV served as an electron cluster source. Measurements were made of the relationship between the emitted energy and the waveguide's dispersion and the number of stages of the laminar medium, which consisted of alternating layers of air and fluoro-plastic. A measurement was made of this relationship in transmittance and nontransmittance bands of the laminar medium. With fulfillment of the condition for parametric resonance, in the transmittance band losses of energy in a stack of  $N$  plates exceed losses in a single plate by a factor of  $N^2$ , and the parametric resonance band is inversely proportional to  $N$ . Curves illustrating these conclusions are shown. For a nontransmitting stack, under certain conditions losses of energy to emission are approximately equal to the energy emitted in a single plate. The square-law variation between losses of energy and the number of plates makes it possible to draw off considerable power from the beam at the frequency of parametric resonance. The authors are grateful to E. D. Gazazyan and E. A. Begloyan for discussion. Figures 3; references: 4 Russian.

USSR

UDC 621.372.821

RADIATION OF A TEM-WAVE FROM A COAXIAL WAVEGUIDE WITH AN INFINITELY WIDE FLANGE

Gor'kiy IZV.VUZ:RADIOFIZIKA [Bulletin of Higher Educational Institutions: Radiophysics] in Russian Vol 20, No 7, Jul 77 pp 1086-1090 manuscript received 21 Jul 76

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[Abstract] Radiation of a TEM-wave from a coaxial waveguide is considered, this waveguide being filled with a homogeneous dielectric between the inner solid ideal conductor and the outer hollow ideal conductor. At the open end the outer conductor terminates into an infinitely wide flange. The solution of the problem according to the Wiener-Hopf-Fok method reduces to the solution of an infinite system of linear algebraic equations with respect to the amplitudes of eigenwaves. Typical numerical results are shown here in the form of graphs. Figures 3; references: 6 Russian.

USSR

UDC 621.372.823.2

DISPERSION EQUATION OF  $HE_{11}^H$ -WAVE OF A TWO-LAYER ELLIPTICAL WAVEGUIDE WHEN  $v\phi = c$

Moscow RADIOTEKHNIKA I ELEKTRONIKA [Radio Engineering and Electronics] in Russian Vol 22, No 8, Aug 77 pp 1725-1726 manuscript received 27 Oct 75

ILARIONOV, YU. A., and SMORGONSKIY, V. YA.

[Abstract] As has been shown, in power accelerators at an energy of 1000 GeV, for production of the regime  $v\phi = c$ , it is advisable to use waveguides of elliptical cross section. Two works in the literature considered only the dispersion equation of a diaphragm-type waveguide for waves  $E_{01}^{ch}$  and  $H_{01}^{ch}$  in a first approximation, and in a third work for the wave  $HE_{11}^{ch}$  in an elliptical waveguide with a rod with  $v\phi = c$ . The present work studies the dispersion equation of a two-layer elliptical waveguide for a wave  $HE_{11}^H$  with  $v\phi = c$  during a change of the parameters of the filling (rod)  $a/b$  and  $\epsilon_1$ , within wide limits. Here  $a$  is the large semi-axis of the rod,  $\epsilon_1$  is its dielectric constant,  $b$  is the large semi-axis of the waveguide. In the case of a prescribed frequency, the formulas and graphs obtained make it possible to select parameters of the filling and eccentricity of a cross section of an elliptical waveguide with a dielectric rod for obtaining a regime  $v\phi = c$  in the case of  $HE_{11}^H$  waves. Figures 3; references: 6 Russian.

USSR

UDC 621.314.252.001.3

SYSTEMS OF PULSE-PHASE DEVICES BASED ON INTEGRATED CIRCUITS

Moscow ELEKTROTEKHNIKA [Electrical Engineering] in Russian No 8, 1977 pp 54-57

BYALIK, V. SH., engineer

[Abstract] Pulse-phase systems, based on integrated microcircuits, and used in the manufacture of phase-shifting devices, are studied. The functioning of multichannel pulse-phase systems is explained. Multichannel systems of this type should be used when the range of regulation must be over  $180^\circ$ , and such systems with single-channel control of counterphase pulses are coming into increasing use, particularly for converters in which the output voltage must be balanced phase-by-phase. The shortcomings of these structures result primarily from the fact that the range of regulation cannot in principle be over  $180^\circ$ . Block diagrams of devices are presented, which consist of a master oscillator, conversion ring, adjustable slave multivibrator, coincidence circuit, shorting device and output device. The construction of each of the subunits is briefly outlined. The electrical characteristics of the total circuit and its response to square wave and sawtooth pulse trains are described. References 7: 6 Russian, 1 Western.

USSR

UDC 621.372.632.029.65

OROTRON -- A FREQUENCY CONVERTER

Moscow RADIOTEKHNIKA I ELEKTRONIKA [Radio Engineering and Electronics] in Russian Vol 22, No 8, Aug 77 pp 1670-1672 manuscript received 26 May 76

RUSIN, F. S., SINENKO, L. A., and KOSTROMIN, V. P.

[Abstract] At present, for frequency conversion (multiplication and division) of frequency in the submillimeter wave bands, practically the very same elements are used as in the centimeter band. However, for a number of reasons they have been found to be of low efficiency in these wave bands. A number of versions of multipliers based on various physical processes have been proposed for operation in the millimeter and submillimeter bands, but they have all been found to be insufficient. The present work describes a new device--the orotron, a frequency converter--which to a considerable extent lacks the above shortcomings. The orotron contains a cathode, an electron beam, a periodic structure, a spherical mirror, two wave guides, an external source of oscillations, and absorbent material. The results are presented of preliminary experimental tests of the device, conducted in autonomous and nonautonomous regimes. The prospects are shown for the use of the orotron as a source and frequency converter of

oscillations of the millimeter and submillimeter wave band. The authors thank V. A. Gol'be, B. A. Gaygerov, and V. S. Kushchu for repeated discussions and valuable council; and A. I. Terekhov, V. A. Bochkov, and F. N. Shoykhet for assistance in conducting the experiment. Figures 1; references 5: 4 Russian, 1 Western.

USSR

UDC 62-52:538.215

UPPER ESTIMATE OF THE MOMENT EFFECTIVE IN CRYOGENIC SUSPENSIONS OF  
NAVIGATIONAL INSTRUMENTS

Moscow AVTOMATIKA I TELEMEXHANIKA [Automatics and Telemechanics] in Russian  
No 8, Aug 77 pp 186-188 manuscript received 19 Apr 76

GORSHKOV, V. A., and RYABOV, A. B., Moscow

[Abstract] During construction of navigational instruments with the use of a superconducting suspension of the sensitive element, it is necessary to know the moments effective in such a suspension. In a work by A. B. Ryabov (see above), which uses the assumption that an analytical function is known which describes the form of the body, relations are obtained for determining these moments. However, the equation of the body surface is not always known, although it is known that the differences of a given surface from the ideal are restricted in absolute value. Consequently, the upper estimate of the moment effective in a superconducting body with a known quantity of deviation from an ideal surface is of interest. The present brief note considers a superconducting body of a form close to spherical, which is located in a magnetic field with an axial symmetry of rotation, and provides an upper estimate of the moment. Figures 1; references: 3 Russian.

USSR

UDC [621.315.2:621.59].016.3.001.24

PERMISSIBLE AND OPTIMAL LOADS ON LIQUID NITROGEN CRYORESISTIVE CABLES

Moscow ELEKTROTEKHNIKA [Electrical Engineering] in Russian No 6, Jun 77  
pp 56-60

LUZGINA, N. K., engineer

[Abstract] This article analyzes two designs: with powder insulation (with and without a pipe for return flow of the cooling agent) and with vacuum superinsulation. The use of powder (aerogel) thermal insulation rather than vacuum insulation increases heat influx from the environment to 5-8 W/m, but also increases reliability, simplicity of installation and operation of cables, reducing repair and maintenance time. In all of the versions, tests of which are described in this article, the conductor was a hollow copper core 50 or 75 mm in diameter, wall thickness 4 mm, the electrical insulation was cable paper saturated with liquid nitrogen. The thermal stability and maximum possible voltages are calculated. Relative costs of installation and maintenance of the two types of cable tested are calculated. Figures 5; references: 2 Russian.



## ATTENUATION OF SUPERCONDUCTING COAXIAL CABLES IN THE FREQUENCY REGION UP TO 17 GHz

Moscow ELEKTROSVYAZ' [Electric Communication] in Russian No 7, Jul 77  
pp 14-20 manuscript received 12 Jun 76

GAL'PEROVICH, D. YA., and GRODNEV, I. I.

[Abstract] In connection with the use of superconducting coaxial cables in communication systems, the change of attenuation of a cable over a wide frequency band is investigated, as well as the minimum values the loss of electromagnetic energy is able to attain in a cable at a specified temperature. It is necessary to perform calculations of the attenuation in accordance with experimental data for the surface resistance of superconducting material and  $\operatorname{tg} \delta$  of the dielectrics. As a result of the experiment the existing hypothesis concerning the nature of attenuation in polymers at cryogenic temperatures was confirmed. The magnitudes of the losses in nonpolar dielectric surpassed forecasts by 1-2 orders of magnitude, and in polar by still more. Attenuation of superconducting cables because of loss in the insulation is large even at frequencies of 12-17 GHz, where earlier an overwhelming effect of the superconductors was anticipated. For reduction of the transmission losses during operation at a frequency up to 3-5 GHz it is necessary to pay principal attention to investigation and improvement of insulation. The authors thank L. F. SUKHORUKOV, A. A. LAPTEV and S. A. GANIN for assistance in calculations and experiments, and N. N. KHRENKOV for helpful discussion of the results of the work. Figures 6; tables 2; references 14: 8 Russian, 6 Western.

USSR

UDC 533.951.2

INVESTIGATION OF THE PROCESS OF REFLECTION OF AN ELECTROMAGNETIC WAVE FROM AN INHOMOGENEOUS LAYERED PLASMA

Moscow RADIOTEKHNIKA I ELEKTRONIKA [Radio Engineering and Electronics] in Russian Vol 22, No 8, Aug 77 pp 1731-1734 manuscript received 5 Apr 76

KARTASHEV, V. G., and SKACHKOV, V. L.

[Abstract] As shown in the literature, in certain cases use of a geometrical-optical method for determining the reflection coefficient during an analysis of the propagation of electromagnetic waves through an inhomogeneous layered plasma leads to crude errors. The present work is concerned with an explanation of the nature of reflection and the development of a new geometrical-optical method of calculating the complex reflection coefficient, which assures satisfactory precision in the case of a high collision frequency. In so doing, the process of reflection of waves from a plasma layer with a linearly increasing concentration is considered. Figures 3; references: 3 Russian.

USSR

UDC 538.56:519.25

STATISTICAL THEORY OF WAVE PROPAGATION THROUGH RANDOM MULTILAYER MEDIA

Gor'kiy IZV.VUZ:RADIOFIZIKA [Bulletin of Higher Educational Institutions: Radiophysics] in Russian Vol 20, No 7, Jul 77 pp 1040-1053 manuscript received 29 Mar 76

KLYATSKIN, V. I. and TATARSKIY, V. I., Institute of Atmospheric Physics, USSR Academy of Sciences

[Abstract] The problem of wave propagation through randomly nonhomogeneous media is analyzed on the basis of three different models of dielectric permittivity fluctuations with a finite correlation radius, including not only small-scale fluctuations describable by the Einstein-Fokker equation for the reflection factor but also large-scale fluctuations to which this equation is not necessarily applicable. The fundamental dynamic wave equation is solved in terms of a delta-correlation process, a telegraphic random process, and a generalized telegraphic random process. Different probability densities of the complex reflection factor are obtained in each case. With attenuation, however, there exists a stationary probability distribution in each case and, if the attenuation is very small, this stationary probability distribution of the modulus of the reflection coefficient does not depend on the probability distribution of the dielectric permittivity. References 12: 8 Russian, 4 Western.

## NONLINEAR THEORY OF INDUCED WAVE SCATTERING

Gor'kiy IZV. VUZ:RADIOFIZIKA [Bulletin of Higher Educational Institutions: Radiophysics] in Russian Vol 20, No 6, 1977 pp 887-892 manuscript received 14 Nov 75; after completion, 23 Aug 76

KHAZANOV, I. V., Scientific-Research Radiophysics Institute

[Abstract] The effects of disintegrative interaction between waves play a considerable role in propagation of intense radiation in nonlinear media. They can result in pumping over of a considerable share of incident power into scattered waves, i.e., hinder passage of radiation through a material. This paper gives some results of examining a unidimensional model of the nonlinear stage of backscattering of waves with fixed phases in a layer of a nonlinear medium. An examination is made of the unidimensional problem of induced scattering of a transverse electromagnetic wave arising when this wave disintegrates into a transverse wave propagated in the reverse direction and into a low-frequency longitudinal wave. The discussion here is limited to the case when it is possible to assume that only two low-frequency waves of identical frequency propagated toward one another take part in interaction with high-frequency waves. Conditions of synchronism are fulfilled for the frequencies and wave vectors of the interacting waves. A specific solution to the dynamic wave interaction problem is found for standing low-frequency waves under stationary conditions. Taking disintegrative processes into account, specific solutions are found for the unidimensional model describing stationary pumping over of energy between high-frequency modes with participation of a single standing low-frequency wave. Particular attention is paid to the existence of conditions of induced scattering under which reflection of radiation is practically absent when it passes through a nonlinear layer. Conditions are detailed for applicability of the results obtained, using disintegration of waves in a plasma as an example. Pumping of energy between high frequency modes can be carried out by means of a single low-frequency wave if detuning from synchronism is sufficiently slight, which is easy to accomplish. The author thanks A. G. Litvak and G. A. Pasmanik for helpful discussions. References: 2 Russian.

## RADIATION DAMPING OF OSCILLATIONS OF THE 'WHISPERING GALLERY' TYPE AT THE TRANSMITTANCE THRESHOLD

Gor'kiy IZV.VUZ:RADIOFIZIKA [Bulletin of Higher Educational Institutions: Radiophysics] in Russian Vol 20, No 6, 1977 pp 876-886 manuscript received 29 Mar 76

SILAKOV, YE. L., Leningrad State University

[Abstract] It is possible to distinguish two mechanisms for damping of oscillations concentrated within a bound region with a transmittance threshold: 1) Damping is caused by the fact that the wave striking the interface from within produces a drifting wave beyond the threshold; and 2) The incident wave undergoes total internal reflection, the field beyond the threshold first diminishes exponentially, and a drifting wave forms far from the threshold. The terms used for this are diffusion of the field through the threshold, or radiation damping of oscillations, the latter being taken from quantum mechanics. Both of these mechanisms are possible for oscillations of the "whispering gallery" type at the transmittance threshold. These oscillations are described by eigenvalues of Helmholtz's equation concentrated near the convex closed interface between two media on the inside of this interface. The two-dimensional problem is discussed here. Oscillations of the "whispering gallery" type are defined in a ray approximation by a system of rays reflected at small angles from the threshold, whereby the glancing angle  $\alpha$ , is related to the radius of curvature of the threshold,  $\rho$ , in the following way:  $\alpha(s) = \kappa \rho^{-1/3}(s)$ , ( $\kappa \ll 1$ ). Here  $s$  is the length of an arc of the threshold and factor  $\kappa$  determines the proximity of the caustic curve of this system of rays to the interface. Eigenvalues corresponding to oscillations of the "whispering gallery" type at the transmittance threshold are determined by Keller-Rubinov equations (1960) in generalized form. These equations take into account the refractive index of the external medium with respect to the internal, symbolized by  $N$ . If the external medium is optically denser,  $N$  is greater than unity, and the rays, refracted, pass through the threshold and form a drifting wave beyond it. Then the Keller-Rubinov equations determine complex eigennumbers. When  $N$  is less than unity the rays undergo total internal reflection and the Keller-Rubinov equations become real. In this instance the imaginary part of the eigenvalue is determined by a slight difference between the absolute value of the reflection coefficient and unity, or by the presence of positive addition of the eigenfunction to threshold impedance, which is critically related to the reflection coefficient. This paper is devoted to finding the real addition to impedance and the imaginary part of eigenvalues when  $N$  is less than unity. For this purpose an eigenfunction is first plotted for outside the threshold by means of the complex ray method. It is found that near the interface there exists an exponentially small wave which is propagated in the direction of the threshold and which determines the slight difference between the absolute value of the reflection coefficient and

unity. The expression for the eigenfunction on the outside of the interface is obtained in the form of the sum of 2 waves, direct, and reflected from the complex caustic. A comparison is made with the asymptotic form of the precise solution for the case of a circle and an ellipse close to circularity. The limits of applicability of the complex ray method and the possibilities for applying it to nonanalytical thresholds are discussed. The author thanks V. N. Krasil'nikov and I. A. Molotkov for consideration of the work, and also V. F. Lazutkin for helpful discussion. Figures 2; references 10: 7 Russian, 3 Western.

USSR

UDC 538.574.6

USING AN APPROXIMATE BOUNDARY CONDITION FOR SOLVING THE PROBLEMS OF DIFFRACTION AND EXCITATION OF ELECTROMAGNETIC WAVES IN NONHOMOGENEOUS MEDIA BY THE GRID METHOD

Gor'kiy IZV.VUZ:RADIOFIZIKA [Bulletin of Higher Educational Institutions: Radiophysics] in Russian Vol 20, No 7, Jul 77 pp 1063-1070 manuscript received 13 Apr 76; after completion 29 Nov 76

SAMOKHIN, A. B. and TSVETKOV, S. V., Moscow Physicotechnical Institute

[Abstract] The condition of radiation at infinity is replaced with a "nonasymptotic" approximate boundary condition at a spherical or cylindrical surface of radius  $kr > 1$ , beyond which surface the medium is assumed to be homogeneous, isotropic, and free of excitation currents. With this boundary condition, the exterior diffraction problem is reduced to the interior diffraction problem for a finite region. The accuracy of this boundary condition is  $O(kr)^{-2}$ , but the true accuracy of the solution must be established by a numerical experiment. The uniqueness of the solution to the boundary-value problem of electrodynamics thus formulated is proven here and the validity range of such an approximate boundary condition is established on the basis of a model problem. The grid method with this approximate boundary condition is applied, for illustration, to the problem of excitation in an ideally conducting cylinder surrounded by a nonhomogeneous medium. The authors thank P. Ya. Ufimtsev for discussion of the results of the work. Figures 5; references 9: 8 Russian, 1 Western.

## PRELIMINARY RESULTS OF MEASURING THE ALTITUDE DISTRIBUTION OF IONOSPHERIC INHOMOGENEITIES INDUCED BY HIGH-POWER SHORTWAVE RADIO TRANSMISSION

Gor'kiy IZV.VUZ:RADIOFIZIKA [Bulletin of Higher Educational Institutions: Radiophysics] in Russian Vol 20, No 6, 1977 pp 939-940 manuscript received 1 Jul 76

MITYAKOVA, E. YE., MYASNIKOV, YE. N. and RAKHLIN, A. V., Scientific-Research Radiophysics Institute

[Abstract] Heating of the ionosphere in a field of high-power radio waves can give rise to inhomogeneities in electron concentration of different scales. Previous measurements of the altitudes of induced inhomogeneities demonstrated that they can span a wide altitude range, for example, 200 to 450 km, although heating of the ionosphere mainly takes place at about 300 km. This brief report discusses an experiment conducted at Gor'kiy from Dec 1975 to Apr 1976, whereby measurements were made of the altitudes of ionospheric inhomogeneities induced by high-power shortwave radio transmission. Altitudes were measured by spatially separated reception of artificial earth satellite (ISZ) signals in the 136 to 137 MHz range. Signals were received from the American orbiting satellites Nimbus-5 and NOAA-2, with a polar orbit close to circular and orbiting at an altitude of about 1000 km. Heating of region F of the ionosphere was accomplished with the high-power shortwave radio transmitter at Zimenki, Gor'kiy oblast, at 4.6 MHz (130 kW transmitter power; antenna gain of about 100). Satellite signals were also received at Zimenki with two spatially remote antennas (200-m base line), facing north to south. Estimates of altitudes of inhomogeneities were made by measuring time shifts between like fluctuations on recordings of signals at the two reception stations. Graphic data showing sections of the perturbed region in the plane of the satellite's orbit for three flights corresponding to different values of the maximum zenith angle and obtained experimentally from single measurements of time shifts are presented. An indication is also made here of the altitude of the F layer's maximum. Inhomogeneities are found within the 250 to 400 km altitude range, both at altitudes near the F layer's maximum and at those considerably higher than it. These data concur with those found earlier. Inhomogeneities are induced by a heating wave near its level of reflection; the existence of inhomogeneities at altitudes considerably higher is unexpected and it can be that processes of "transfer" of inhomogeneities occurring in the perturbed region are in operation, possibly along the geomagnetic field. It is suggested that additional data should be accumulated and additional measurements made at several frequencies for a more detailed analysis of the altitude distribution of these inhomogeneities. The authors thank L. M. Yerukhimov for help in organization of the experiment and discussion of the results and Yu. P. Pimankin for help in adjustment of the equipment. Figures 1; references 2: 1 Russian, 1 Western.

USSR

UDC 621.371

RANDOM AND REGULAR VARIATIONS OF THE AZIMUTHS OF SHORT RADIO WAVES DURING  
THEIR EXTRAFAR-RANGE PROPAGATION

Gor'kiy IZV.VUZ:RADIOFIZIKA [Bulletin of Higher Educational Institutions:  
Radiophysics] in Russian Vol 20, No 7, Jul 77 pp 1108-1109 manuscript  
received 8 Jul 76

AGARYSHEV, A. I. and UNUCHKOV, V. YE., Irkutsk State University

[Abstract] The azimuthal characteristics of back-echo signals were studied in Irkutsk during the periods from October 1974 to March 1975 and from September 1975 to March 1976, with the transmitter located 2300 km away in Khabarovsk. Pulses of 2 ms duration at frequencies within the 14-18.5 MHz range were tested, with 66 percent of all measurements made at one frequency near 17 MHz. On the basis of experimental data pertaining to signal amplitudes, it has been possible to separate the regular component from the random component in the azimuth variation. The large random component, which makes it difficult to predict the result of an individual measurement, is attributed to deviations from the "mean" ionosphere. Figures 2; tables 1; references: 4 Russian.

USSR

UDC 621.371.22

DIFFRACTIVE FOCUSING OF WAVES IN PERIODICALLY NONHOMOGENEOUS LAYERS

Gor'kiy IZV.VUZ:RADIOFIZIKA [Bulletin of Higher Educational Institutions:  
Radiophysics] in Russian Vol 20, No 7, Jul 77 pp 1054-1062 manuscript  
received 23 Apr 76

BUTS, V. A. and MACHEKHIN, YU. P.

[Abstract] The conditions are analyzed under which waves scattered in periodically nonhomogeneous layers can be focused into resonance waves. This possibility is found to be enhanced by the presence of a second layer boundary, i.e., by the finiteness of the layer width. Such waves are then shown to be essentially surface waves. Both the acoustic case and the electromagnetic case are considered. References: 4 Russian.

USSR

UDC 621.371.25

RESONANT INTERACTION BETWEEN ELECTROMAGNETIC WAVES AND A NONUNIFORM STREAM  
OF MAGNETICALLY ACTIVE PLASMA

Gor'kiy IZV.VUZ:RADIOFIZIKA [Bulletin of Higher Educational Institutions:  
Radiophysics] in Russian Vol 20, No 7, Jul 77 pp 982-986 manuscript  
received 6 Jul 76

GAVRILENKO, V. G. and ZELEKSON, L. A., Gor'kiy State University

[Abstract] The effect of resonance on the propagation of electromagnetic waves through a plasma jet is analyzed in the case where a cold collisionless plasma with a uniform electron concentration moves in a strong constant external magnetic field parallel to it, at a velocity much lower than the speed of light. The motion of ions in the wave field is discounted and the plasma is regarded as a uniaxial crystal. The equation of the extraordinary wave is reduced to the Gaussian hypergeometric equation. The expressions for the reflection coefficient and the transmission coefficient are simplified by means of an asymptotic representation, whereupon the dispersion equation characterizing the frequency spectrum of natural electromagnetic waves in the jet is also obtained. An analysis of the energy transfer between jet and wave indicates that the resonance effect is not determined entirely by the number of fast and slow particles but also by thermal motion. Figures 2; references 13: 12 Russian, 1 Western.

USSR

UDC 621.371.25

RADIATION OF ELECTROMAGNETIC WAVES THROUGH A PLASMA AT FREQUENCIES BELOW  
THE UPPER HYBRID

Gor'kiy IZV.VUZ:RADIOFIZIKA [Bulletin of High Educational Institutions:  
Radiophysics] in Russian Vol 20, No 7, Jul 77 pp 991-1003 manuscript  
received 10 Feb 76

BELLYUSTIN, N. S., Scientific-Research Institute of Radiophysics

[Abstract] The refractive index for one of the normal waves in a magnetically active plasma may become infinitely large at some resonance angle between the wave vector and the magnetic field. A resonance angle for the extraordinary wave exists within the frequency range below but near the upper hybrid. This appears relevant to the anomalous absorption of the ordinary wave by the F-layer of the ionosphere, upon incidence at a perturbation region, and to resonant scattering of the ordinary wave into the extraordinary wave by artificially seeded inhomogeneities. The radiation of an extraordinary wave by an arbitrarily given source at a frequency near the upper hybrid



is analyzed here by solving the equation of a harmonic field in a magnetically active plasma. This is done, considering a homogeneous medium, by resolution into plane waves. The extraordinary component is then taken at a sufficiently large distance from the source. The results are applied to two pertinent examples: an electric current distribution which, in the case of a source with vanishingly small dimensions along and across the magnetic field, becomes an arbitrarily oriented elementary electric dipole, and scattering of an ordinary wave by an inhomogeneity. Figures 3; references 10: 9 Russian, 1 Western.

USSR

UDC 621.371.25

EXCITATION OF A IONOSPHERIC WAVEGUIDE AT THE LOWER HYBRID RESONANCE  
FREQUENCY OF FLUXES OF HYPERTHERMAL PARTICLES

Gor'kiy IZV.VUZ:RADIOFIZIKA [Bulletin of Higher Educational Institutions: Radiophysics] in Russian Vol 20, No 7, Jul 77 pp 1004-1016 manuscript received 28 Jan 76

TRAKHTENGERTS, V. YU. and SHAPAYEV, V. I., Scientific Research Institute of Radiophysics

[Abstract] A lower hybrid resonance waveguide such as one found in the ionosphere is considered in order to explain the occurrence of a very low frequency whistle around satellites. Both phase and group trajectories of very low frequency waves are calculated on the basis of Snell's law for a layerwise nonhomogeneous medium. The excitation of this waveguide by fluxes of hyperthermal electrons and protons is analyzed, with transverse proton fluxes found to be most effective in this report. On the assumption that the channel width is much larger than the radiation wavelength, the approximation of geometrical optics is applicable here. The factors limiting the buildup of lower hybrid resonance waves and stabilizing the spectrum of very low frequency radiation are found to include linear effects of pullout from the source (instability) zone by the mechanism of group propagation, and linear interaction between waves in the form of induced scattering, which results in "leakage" of the source energy with its subsequent linear dissipation; the effects of quasilinear relaxation and resulting amplitude saturation are found to be less significant here because the wave energy is highly localized within the ionosphere inside the lower hybrid resonance waveguide channel. Figures 2; references 9: 6 Russian, 3 Western.

USSR

UDC 621.371.25

EXCITATION OF MAGNETIC PULSATIONS BY RADIATION IMPINGING ON THE IONOSPHERE  
FROM A POWERFUL SHORTWAVE TRANSMITTER

Gor'kiy IZV.VUZ:RADIOFIZIKA [Bulletin of Higher Educational Institutions: Radiophysics] in Russian Vol 20, No 7, Jul 77 pp 1017-1019 manuscript received 5 Jul 76

GETMANTSEV, G. G., GUL'YEL'MI, A. V., KLAYN, B. I., KOTIK, D. S., KRYLOV, S. M., MITYAKOV, N. A., RAPOPORT, V. O., TRAKHTENGERTS, V. YU., and TROITSKAYA, V. A., Scientific Research Institute of Radiophysics

[Abstract] Experiments are being conducted with artificial excitation of the ionosphere by a powerful shortwave radio transmitter, so that nonlinear plasma processes can be studied under parameter relations not easily simulated in the laboratory. Of particular interest is the low-frequency range corresponding to geomagnetic pulsations, where the effect of the ionic component becomes significant. Such experiments were performed during the period from 30 June to 18 July 1975, covering the occurrence of one geomagnetic storm, with a 130-kW 4.61-MHz radio transmitter pulse modulated at a 50 percent duty cycle and a repetition rate ranging from 0.01 to 3.1 Hz. The antenna had a vertical radiation pattern and a gain of 150, the receiver was located 105 km east of the transmitter. Measurements were made with a low-noise inductive magnetometer, an analog magnetophone was used for recording, and the data were processed on a dynamic spectrum analyzer. The high level of natural pulsations masked artificial pulsations within the 0.01-0.7 Hz range, but amplitude modulation at 3.1 Hz revealed quasi-monochromatic signals in the north-south as well as in the east-west direction of the magnetic field. The results are interpreted in terms of heating of the relatively thin E-layer. The authors thank G. P. Komrakov, N. A. Zuykov, Yu. S. Golub, B. V. Dovbn and N. N. Rusakov for help in conducting the experiment.

USSR

UDC 621.371.25

SPECTRAL ANALYSIS OF VARIATIONS IN VLF SIGNALS IN THE EARTH-IONOSPHERE  
WAVEGUIDE

Gor'kiy IZV.VUZ:RADIOFIZIKA [Bulletin of Higher Educational Institutions: Radiophysics] in Russian Vol 20, No 6, 1977 pp 861-867 manuscript received 29 Mar 76

BEZRODNYI, V. G., SINYAVSKIY, S. N., SHUBOVA, R. S., and YAMPOL'SKIY, YU. M., Institute of Radiophysics and Electronics, Ukrainian SSR Academy of Sciences

[Abstract] From 1973 to 1975 inclusive at the Institute of Radiophysics and Electronics, Ukrainian SSR Academy of Sciences, experimental studies

were made of variations in the parameters of very low frequency (VLF) radio signals in the earth-ionosphere waveguide duct. This paper presents some of the results obtained in making these studies. Measurements were made in the environs of Khar'kov at different seasons in moderately long cycles of 10 to 20 days each. Measurements were made in the 10 to 20 kHz frequency range of variations in amplitude and phase at one station and of differences in phases at spatially remote stations. The phase indication equipment used is described in an earlier paper. The following stations were used as highly stable signal sources: The Omega station in Aldra, Norway (10.2 and 13.6 kHz, length of path approximately 2200 km), station GBR (Rugby, England) (16 kHz, approximately 2600 km), and station NAA in Halifax, USA [sic] (17.8 kHz, approximately 7000 km). Individual paths of propagation were oriented from west to east and lay within an angle of approximately 45°. Separation of receiving stations when measuring phase difference was performed across the direction of propagation at a distance of from 40 to 120 km. Restrictions on the sensitivity of measuring apparatus made it possible to subject only nighttime segments of 24-hour recordings to statistical analysis. Estimates were made of the power spectra of fluctuations in relative amplitude, phase, and phase difference. Experimental data were processed on an M-222 computer. Methods of preparing data for processing are described. Spectra are shown for fluctuations in amplitude and phase obtained in all measurement cycles during this time period. Within the range of fluctuating frequencies studied, all fluctuations in amplitude and phase can be approximated sufficiently well with a power function:  $S_{a,\phi}(F) = C_{a,\phi} F^{-\alpha}$ , where  $S_{a,\phi}$  is the power spectrum of fluctuations in amplitude and phase,  $C_{a,\phi}$  is a factor, different for amplitude and phase spectra, which depends on the reception frequency and the position of the observation station relative to the transmitter and to the interference pattern of the field in the waveguide. Exponent  $\alpha$  does not depend on these factors and lies within the range of 2 to 2.3. These spectra are used further to derive statistical characteristics such as r.m.s. deviation in phase, r.m.s. deviation in amplitude, and r.m.s. deviation in frequency for various frequencies and r.m.s. deviation in phase difference for various degrees of spatial separation. The value of the exponent of the above power function also does not depend on the season and length and orientation of the path of propagation. The hypothesis of migration of ionospheric inhomogeneities at a steady rate is used to apply the measurement results to determine the typical rates of migration and dimensional spectra of these inhomogeneities. Figures 9; references 6: 5 Russian, 1 Western.

USSR

UDC 621.385.6.001.5

DYNAMIC SENSITIVITY TO THE ELECTRON FLOW DEFLECTION IN THE CASE OF  
INTERACTION WITH A TRANSVERSE MAGNETIC FIELD

Moscow RADIOTEKHNIKA I ELEKTRONIKA [Radio Engineering and Electronics] in  
Russian Vol 22, No 8, Aug 77 pp 1750-1752 manuscript received 30 Mar 76

BYSTROV, YU. A.

[Abstract] The effect of interaction between an electron flow and a transverse magnetic field is widely used in electron-beam devices, as well as in various measuring transducers with magnetic control. The dynamic properties of such devices, which determine the possibility of undistorted conversion of a signal, depend on a number of factors, in particular on the time of transit by the electrons of the interaction distance. It is possible uniquely to characterize this effect by the dynamic sensitivity to deflection in the case where a variable magnetic field  $B = B \cos \omega t$  acts on the electron flow formed by a two-dimensional anode and cathode. Figures 2; references: 2 Russian.

USSR

UDC 621.385.032.21.001.5

COMMENTS ON THE MECHANISM OF THE EMISSION OF ELECTRONS FROM AN MIM-CATHODE

Moscow RADIOTEKHNIKA I ELEKTRONIKA [Radio Engineering and Electronics] in  
Russian Vol 22, No 8, Aug 77 pp 1747-1750 manuscript received 29 Mar 76

VOROB'YEV, G. A., SUTYAGIN, A. V., and TROYAN, P. YE.

[Abstract] In a previous paper [G. A. Vorob'yev, P. Ye. Troyan, Radiotekhnika i elektronika, 1975, 20, 11, 2415] it was assumed that electrons from a MIM-cathode are emitted through an aperture in the upper electrode. The results of additional observations shown in the present short communication verify this assumption. An Al-Silicon nitride-Al cathode was used in the work. The thickness of the upper electrode amounted to 200 Å. Photographs are shown of 1) The points of luminescence of the cathode; and 2) The surface of the upper electrode of the cathode -- both at various stages of operation. Figures 3; references: 1 Russian.

CZECHOSLOVAKIA

POSSIBILITIES OF SEEING IN THE DARK

Prague SDELOVACI TECHNIKA in Czech Vol 25, No 7, Jul 77 pp 259-263

PRIBYL, FRANTISEK

[Abstract] Vision in the region of near infrared light waves was developed during World War II under the designation of "noctovision." In the method of vision an object is illuminated by a source of light invisible to the human eye, with a wave length of above 0.8 micrometers. The illuminated object is observed through a picture objective which converts infrared radiation to a visible image. A photocathode sensitive to radiation controls emission electrodes which are focused onto a luminescent screen where they form a visible image. In theory the increase in intensity may be 100 times. Another method allowing vision in the dark is the method of detection of thermal radiation; this method is widely used in military applications. Sensitivity up to a few tenths of a degree centigrade may be achieved. Differences in transmission are also caused by the different emissivities of surfaces of various objects. The third method of vision in the dark is based on amplification of the residual radiation of the night sky. This light consists of moonlight, starlight, air glow, and of thermal radiation of the troposphere. The Czechoslovak firm TESLA markets an infrared converter TESLA VUVET 22QA4i. It is used in the production of photographic materials, verification of the authenticity of pictures and documents, and determination of faults in opaque materials by infrared microscopes. Vision under the conditions of very low light intensity is made possible by amplifiers, which may increase the light intensity up to 100 times. The photocathode needed in this method requires a very advanced process in glass making. The image amplifier for this method is provided with a thread optical device. It is equipped with a through-flow secondary emission device. The electrons emitted by the photocathode are accelerated and penetrate with a high energy charge into a porous layer of KCl of the first dynode, where they release secondary electrons. These are accelerated with a potential higher than that in the preceding stage, and thus an increase of 10 times can be obtained in the electron radiation. A typical amplifier of this type is the ASTRACON marketed by the Westinghouse Corporation. The most efficient type of picture amplifier is the channel type offered by MOULLARD. Electron intensity amplification of up to  $10^8$  may be achieved. The channels are made of a special lead containing glass. The electrode is made of spluttered Cr-Ni. Photoelectrons focused by an anode system enter a channel multiplier, are accelerated and enter a luminescent screen. The voltage on the channel plate can vary from 0.4 to 1.4 kV. Amplification of light of up to  $10^5$  times was achieved in practical applications. Figures 11; references 7: 2 Czech, 5 Western.

Instruments and Measuring Devices;  
Methods of Measuring

USSR

UDC 389.64.621.317.725

EVALUATION OF THE TECHNICAL QUALITY OF DIGITAL DC VOLTMETERS

Moscow PRIBORY I SISTEMY UPRAVLENIYA [Control Devices and Systems] in Russian No 7, Jul 77 pp 27-28

ZEGZHDA, P. D., and SMOLKO, L. V., candidates in technical sciences;  
KALACHEV, A. I. and LABUNETS, V. S., engineers

[Abstract] For the purpose of a comparative evaluation of the technical quality of the many types of digital dc voltmeters on the market, their engineering efficacy is defined as the ratio of performance capacity (in ranks) to unit production cost (in terms of mass). Relations are derived for both, on the basis of a mathematical model and dimensional analysis, and thirty different instrument models are rated in this way. A classification of these instruments according to the type of components and according to the mode of conversion points to the two main areas in which improvements have been and continue to be made since 1960 as the base reference year, namely: technology and design. Figures 1; tables 1; references: 5 Russian.

USSR

UDC 621.317.39

A MORE ACCURATE CONVERSION OF NONELECTRICAL QUANTITIES TO VOLTAGE

Moscow PRIBORY I SISTEMY UPRAVLENIYA [Control Devices and Systems] in Russian No 7, Jul 77 pp 28-29

SKRIPNIK, YU. A., dr in technical sciences

[Abstract] A method of converting nonelectrical quantities to voltage is shown where the transfer ratios of both the forward (converter) stage and the compensating feedback (inverter) stage are simultaneously modulated in synchronism. Thus, not the total input quantity but only its increment, proportional to the percent modulation of the conversion ratio, has to be balanced. On the basis of the functional schematic diagram of such a transducer and the fundamental relations between input and output quantities, the performance is analyzed in terms of reduced instability and higher accuracy. This method of balancing conversion is applicable to many more nonelectrical quantities than the conventional method, especially to those where differences of levels (temperature, flow rate) cannot be easily established by a direct measurement and also others where the range of values is very wide. Figures 2; references: 6 Russian.

USSR

UDC 621.317.444.029.7

ON THE STABILITY AND THE WORKING RANGE OF ONE-COMPONENT QUANTUM MAGNETOMETER WITH FEEDBACK BASED ON HANLE'S EFFECT

Moscow RADIOTEKHNIKA I ELEKTRONIKA [Radio Engineering and Electronics] in Russian Vol 22, No 8, Aug 77 pp 1631-1634 manuscript received 21 May 76

KOTKIN, A. L., MAYORSHIN, V. V., and UMARKHODZHAYEV, R. M.

[Abstract] At present, the phenomena of intersection of magnetic sublevels of the principal state of atoms--the Hanle effect--is widely used for measurement of weak magnetic fields. In order to expand the working range of magnetometers constructed on the basis of the Hanle effect, a feedback is used which automatically compensates the magnetic field being measured. In the present work problems are considered of the effect of the feedback circuit on the stability and working range of a one-component quantum magnetometer when the magnetic field being measured is directed perpendicular to the axis of the pickup of the device, in the case of slow and rapid modulation. A block diagram and the principles of action of the magnetometer are presented. It is shown that use of parametric resonance in devices with feedback is preferable. Figures 2; references 11: 6 Russian, 5 Western.

USSR

UDC 621.398.694.3

A FREQUENCY TRANSDUCER BASED ON A GENERATOR WITH AN ACTIVE RC NULLING NETWORK

Moscow PRIBORY I SISTEMY UPRAVLENIYA [Control Devices and Systems] in Russian No 7, Jul 77 pp 29-31

KHRISTICH, V. V., candidate in technical sciences, and GRIGOR'YEV, V. S., engineer

[Abstract] A frequency transducer [datchik] has been developed at the Taganrog Radio Engineering Institute imeni V. D. Kalmykov which contains a generator with an active RC nulling network and is intended for measuring small variations of temperature, pressure, or other quantities convertible to electrical resistance. Its circuit consists essentially of an operational amplifier with frequency-independent positive and negative feedbacks, an active RC nulling network formed by an integrating amplifier and a differentiating amplifier which connect to a resistive adder, an instrument bridge, and another operational amplifier with negative feedback. Its nonlinearity does not exceed 1 percent at a frequency deviation within 30 percent (1680 Hz reference), its nominal sensitivity is 60 and can be raised by means of an adjustable resistor, its output voltage is 4.3 V and almost constant. Figures 1; references 5: 3 Russian, 2 Western.

THE PROPOSED STANDARD: 'MEANS OF MEASURING PRESSURE. TERMINOLOGY AND DEFINITIONS'

Moscow PRIBORY I SISTEMY UPRAVLENIYA [Control Devices and Systems] in Russian No 8, 1977 pp 62-63

KREMLEVSKIY, P. P., dr of technical sciences and department head of the Leningrad affiliate of VISM [All-Union Institute of Standards and Metrology]

[Abstract] This article outlines the writer's objections to the standard proposed for pressure-measuring instrument terminology developed by the VNIIM [All-Union Scientific Research Institute of Metrology] imeni D. I. Mendeleev in Leningrad. In his opinion the proposed standard to a large extent does not meet the requirements of being based on a good system for classifying pressure-measuring instruments, of dispensing with arbitrary terminology and jargon, of being convenient to deal with, and of being on a high scientific level. It requires considerable revision. Comments are given on individual points of the proposed standard. The title itself is inconsistent with that used in standards of a similar sort, where the words "instruments for measuring" are used instead of "means of measuring." Often jargon terms are included which do not accurately describe the device defined or which do not precisely differentiate it from similar devices, or which are totally misleading. Acronyms present a special problem in this regard. The term "variable pressure manometer" is considered unnecessary, because "variable pressure" is defined as "pressure which changes with time," and in fact all pressure changes with time, and the question is at what rate it changes. The response of the manometer (its dynamic characteristics) thus determines its worth. There are no such things as "capacitive" and "inductive" pressure transducers; these instruments use secondary devices for reading capacitance and induction and do not convert directly, as is the case with piezoelectric transducers. Certain recommended replacement terms do not describe existing devices. A "U-type" manometer should not replace the term "double-tube" manometer, for modern devices do not use a U-shaped glass tube but a drilled steel tube which is not U-shaped; and, furthermore, single-tube manometers are still in current use, and the distinction should be kept. Some existing devices are not defined at all, such as "piezoelectric manometer" and "float-type manometer." The latter type is being manufactured on a large scale. Some definitions are strange and nonsensical: The definition for "resistance manometer" in no way describes a manganin manometer, for example. The classification of manometers according to principle of operation does not follow that used in the current standard and is erroneous. The terms "manometer" and "differential manometer" are used inconsistently almost throughout. Some terms are undefined; this defect is supposedly corrected by an appendix; but the appendix is also in need of correction and some terminology is controversial or superfluous. The distinction between "pressure gradient" and "difference in pressure" is not clearly defined. Numerous other points are made. It is concluded that this draft of the standard requires extensive correction and revision and that issuing it in its present state would cause great damage.



## CZECHOSLOVAKIA

### SOVIET INSTRUMENTATION IN PRAGUE

Prague SDELOVACI TECHNIKA in Czech Vol 25, No 7, Jul 77 p 257

[Abstract] This year's Symposium of the Comecon countries concerning specialization and cooperation in the production of electronic instruments was held in mid-May in Prague at the buildings of the Soviet Economic Representation. An exposition formed part of the Symposium; about half of the exhibits were electronic instruments distributed by the Soviet Unit MASPRIBORINTORG [expansion unknown]; the rest was instrumentation produced in East Germany, Poland, and by the Czechoslovak firm TESLA. The Soviet exhibits were mainly those used in determination of electrical data such as recording amplifiers, phase recorders, recorders of amplitude characteristics, oscilloscopes, and signal generators. Although the catalog of MASPRIBORINTORG shows 51 different instruments, only a few were shown. Among those were: oscilloscopes G4-93, G4-102A, G4-107, and the high capacity generator G4-118. Impulse generators with a wide zone of operation were represented by instruments G5-46 and G5-53. The television generator G6-8 is suitable for circuit control. The rubidium oscillation counter C1-50 has high stability. Amplifiers U3-29 and U3-28 operate at frequencies between 20 kHz and 100 MHz. There were many Volt-Ampere-Ohm meters of the V3 and V7 series. Semiconductor oscilloscopes S1-71 and S1-75 were also shown. TESLA announced at the Symposium that a new plant for nuclear technology was being established. Figures 3.

USSR

UDC 621.3.012.8.001.24

CALCULATION OF THE PARAMETERS OF AN EQUIVALENT CIRCUIT (MODEL) OF A T-  
CONNECTION OF MICROSTRIP LINES

Moscow RADIOTEKHNIKA [Radio Engineering] in Russian No 8, 1977 pp 85-87  
manuscript received 6 Oct 75; after completion, 1 Jul 76

DEMENT'YEVA, A. S. and MITSSENGENDLER, I. S.

[Abstract] In developing microstrip microwave equipment it becomes necessary to determine the geometrical dimensions of components containing T-connections of microstrip lines. With sufficiently high frequencies T-connections cannot be considered simple connections of microstrip lines at points corresponding to intersection of their axes, but they are inhomogeneous and can usually be modeled with several equivalent circuits applied to corresponding reference planes. Analytical expressions which fully define the parameters of an equivalent circuit, including the positions of reference planes, for a wide range of wave resistance ratios are available only for a certain model of microstrip lines described in an earlier paper from the literature and diagrammed here. Expressions for determining the parameters of the components of this model are given here. This model is sufficiently suitable for determining the electrical characteristics of multistrip components with T-connections with known geometrical dimensions, but it is not suitable for design purposes. This paper considers the equivalent circuit of a simpler model of a T-connection which does not contain series or parallel reactive components. This model is characterized by three parameters which determine the position of reference planes and by a transformation coefficient computed by formulas used in the earlier paper and repeated here. The parameters of the new model are determined by comparing it with the previous one for cases when one of the lines (each in succession) is a closed loop of such length that at a certain frequency a short circuit is created at two specific points, i.e., the coefficient for transmission of energy from one remaining line to the other equals zero. An algorithm is derived from which a program was written for calculating the values of the parameters determining the positions of reference planes and the transformation coefficient. Calculation results for a number of combinations of wave resistances (line widths) forming a T-connection are given in a table. Different models were constructed and compared with actual equipment by calculating the frequency versus attenuation characteristics for a 50-Ohm line with a closed 35-Ohm loop 2.82 mm long, with a polycore plate 0.5 mm thick. An experimental determination was made of this relationship for part of the frequency range. All models with the exception of the simplest corresponding to simple connection of microstrip lines at the point of axis intersection yielded close results and satisfactory agreement between calculated and experimental characteristics. Figures 3; tables 1; references: 2 Western.

CZECHOSLOVAKIA

UDC 621.372.821

QUICK COMPUTATION OF PARAMETERS OF UNSHIELDED COUPLED MICROSTRIP TRANSMISSION LINES LOCATED ON CORUNDUM SUBSTRATES

Prague SLABOPROUDY OBZOR [Week Current Review] in Czech Vol 38, No 8, Aug 77  
pp 378-379

ZEHENTNER, JAN, Faculty of Electrical Engineering, Czech Technical University,  
Prague

[Abstract] A fast method of approximate calculations of characteristic impedances and of effective permittivities of even and odd modes for unshielded microstrip transmission lines located on dielectric substrates with a relative permittivity of 10 is presented. The approximations are based on polynomials with a maximum order of four. The use of this calculation method speeds up considerably the usual method of designing microwave integrated circuits. The method is approximately 100 times faster than the method proposed by Ramadan and Westgate in MICROWAVE JOURNAL Vol 14, No 7, 1977, pp 30-34. Figures 3; references 6: 3 Czech, 3 Western.

## PRINCIPLE OF DUAL SIGNAL AMPLIFICATION

Moscow RADIOTEKHNIKA [Radio Engineering] in Russian No 8, 1977 pp 58-61  
manuscript received 4 Aug 75; after completion, 11 Jun 76

VOLGIN, L. I.

[Abstract] The quality of the majority of closed electrical circuits with negative feedback can be increased by reducing the statism error or by making possible a constant statism error when the parameters of the negative feedback circuit are changed. This paper examines a possibility, not dealt with earlier, for increasing the stability and reducing the statism error of closed circuits with negative feedback. This method consists in designing the closed circuit in accordance with the dual signal amplification principle. According to this principle, a minimal statism error is possible in a closed circuit with negative feedback when the  $X_1$  input and  $X_4$  output signals of the circuit (current and voltage) are respectively dual with respect to the  $X_2$  input and  $X_3$  output signals of the amplifier (voltage and current) on whose basis the closed circuit in question is designed. In other words, the type of amplifier should be dual with respect to the type of closed circuit. A proof of this principle is given in this paper. A table is presented which illustrates four variants for designing closed circuits with negative feedback as a function of the type of circuit and type of amplifier. Current and voltage amplifiers and conduction and resistance boosters are respectively dual with regard to potential, current, impedance, and admittance circuits. Individual variants are discussed with reference to the canonical form for writing the basic feedback equation. In designing a feedback circuit according to the principle of dual signal amplification the statism error is equal to that of a signal repeater of the asymptotic type and does not depend on the parameters of the feedback circuit. This is a valuable asset for many applications of closed circuits with negative feedback. It is possible to increase the input immittance and reduce the output immittance of the amplifier further by connecting impedance converters to the input and output of the amplifier. Potential closed circuits are the most widely used, and these are designed on the basis of voltage amplifiers. Continuing the trend of improving and expanding the variety of integrated operational voltage amplifiers alone is not justified, in light of the fact that they will not minimize the error, and in fact represent the least favorable variant. Figures 2; tables 1; references 3: 2 Russian, 1 Western.

USSR

UDC 621.372.061

#### CALCULATION OF VOLTAGES AT P-N JUNCTIONS OF DIODES IN COMPLEX CIRCUITS

Kiyev IZV.VUZ:RADIOELEKTRONIKA [Bulletin of Higher Educational Institutions: Radio Electronics] in Russian Vol 20, No 6, Jun 77 pp 90-95 manuscript received 29 Sep 75; after revision, 1 Nov 76

SBORIK, B. T., and KOZLOV, V. I.

[Abstract] An analysis of the characteristics of mixers which contain semiconductor diodes can only be made in the case where the values are known of the voltages (alternating and direct) at each of the diodes, in the case of a specified heterodyne power. As a rule, in input circuits of the microwave band there are some semiconductor diodes and a general source of heterodyne power. Consequently, the problem arises of calculation of the magnitude of the voltages at p-n junctions of the diodes in a circuit being analyzed, for a specified emf and internal resistance of the source. The complexity of the problem involves the nonlinear dependence of the conductivity of the diode junction on the voltage applied to it. In the present work a solution of the problem indicated is illustrated, using as an example a circuit of a general kind which contains two diodes, the nonlinear conductivity of which are taken outside the circuit. A functional diagram of the program, an algorithm of calculation, and the results of calculation on an electronic computer for the circuit of a balanced mixer are presented. An example is presented which shows the possibility of determining the amount of voltage at p-n junctions of diodes for any circuit which contains elements, with both concentrated and distributed constants. Figures 4; tables 2; references: 3 Russian.

USSR

UDC 621.372.061

#### ANALYSIS OF RADIOELECTRONIC NETWORKS BY THE METHOD OF OPTIMUM ROLLING UP OF SUBSYSTEMS

Kiyev IZV.VUZ:RADIOELEKTRONIKA [Bulletin of Higher Educational Institutions: Radio Electronics] in Russian Vol 20, No 6, Jun 77 pp 52-56 manuscript received 9 Nov 76

BAZILEVICH, R. P. and ROMANISHIN, YU. M.

[Abstract] In a previous work by R. P. Bazilevich, methods of rolling up (reduction) of the circuit of a network are used during an analysis of both linear and nonlinear circuits. However, problems of determining the order of rolling up of the circuit on the basis of specific optimized

criteria were practically not investigated. In the present work the criteria of optimumness are determined, and the problem is set of determining the optimum sequence of rolling up with respect to the specified criterion, methods for its solution are designated, and two algorithms, precise and heuristic, are considered for construction of an optimum folding. The efficiency of the use of the algorithms presented is substantially increased by conducting a preliminary analysis of the network topology, as the result of which it is possible to decrease the dimensions of the problems. A functional diagram is presented of an algorithm of search for a quasi-optimum folding. Figures 2; references: 2 Russian.

USSR

UDC 621.382

#### SPECIAL-APPLICATION HYBRID INTEGRATED CIRCUITS FOR ELECTRONIC MEASURING TECHNOLOGY

Moscow PRIBORY I SISTEMY UPRAVLENIYA [Control Devices and Systems] in Russian No 8, 1977 pp 43-44

SMELYANSKIY, I. L., and TAMBERG, YU. G., candidates in technical sciences

[Abstract] This article reports on development work under way on special-application hybrid integrated circuits at VNIIEP [All-Union Scientific Research Institute of Electronic Instruments] in Leningrad. Under development are new types of operational amplifiers (OU's) with faster response and higher precision, comparators, new types of voltage dividers, and voltage stabilizers for powering OU's and logic elements. Three new OU's and two new voltage stabilizers are complete. The new OU's, the KMP816UD3, KMP816UD4, and KMP816UD5, have improved gain, input resistance, input current, temperature-related drift, and output voltage build-up rate. These OU's have a metal and glass body with 14 leads and measure  $29.5 \times 19.5 \times 5 \text{ mm}^3$  (body). They were designed for use in high-current, rapid-response measuring converters. A table of characteristics of these three OU's is presented. These OU's are convenient to use because of their universality with respect to power supply, their internal bias-voltage balancing feature, and short-circuiting protection of their common output lead. The KMP817YeN3 voltage stabilizer has a metal and glass body and 28 leads and is designed to power logic elements with 5 V of stabilized voltage. Its body measures  $39.5 \times 29.5 \times 5 \text{ mm}^3$ . An added external resistor (potentiometer) makes it possible to regulate the voltage output within the range of 3 to 6 V. Its load current can be increased to 2 A and more by adding an external transistor. The KMP817YeN4 voltage stabilizer uses the same body and is designed for supplying differential and operational amplifiers and other analog and digital-analog measuring equipment. An added external potentiometer makes it possible to regulate both output

voltages simultaneously within the range of  $\pm 8$  to  $\pm 20$  V. An external transistor can raise the load current to 1 A and more. Both of these stabilizers feature built-in electronic protection from current overloads, short-circuits, and overvoltages, and from above-critical power surges. The stabilizer returns automatically to the functioning state after the emergency is over. In addition, VNIIEP is developing and manufacturing a large line of thin-film resistive voltage dividers designed for use in code-voltage and voltage-code converters and other computer and measuring equipment. Special orders will be filled for any combination of parameters desired. Tables of characteristics are presented. Tables 4; references: 2 Russian.

USSR

UDC 621.382.2

#### 'PACKET' MULTIPACKAGE MICROASSEMBLIES

Moscow PRIBORY I SISTEMY UPRAVLENIYA [Control Devices and Systems] in Russian No 6, 1977 p 54

NIKOLAYEV, YE. I., candidate in technical sciences, and KOSENKOV, S. M., MARKUS, M. M., SCHEPITSKIY, Z. A., TYAPIN, V. I., and KHRAPKO, YE. Z., engineers

[Abstract] A system of mutually matched potential logical elements--multipackage microassemblies, intended for construction of equipment for discrete automation and computation technology--has been developed and is being manufactured. (See OST [All-Union Standard] 5.8354-74. "Packet" Microassemblies. Directions for use.) The microassemblies are made in form of solid microunits which can contain up to eight complementary integrated circuits (IC) and the decoupling capacitor of a supply circuit. They are potted with a solid compound and placed in a metal housing. Three versions (type dimensions) of the microassembly are made, which differ in the number of complementary IC -- eight, four or two. Approximately 100 circuit types enter into the composition of the system. These circuits differ according to their functional purposes and type dimensions. As a function of the form of the complementing IC, each circuit type can have several modifications. The functional composition of the system of microassemblies is presented. The electrical parameters of the microassembly are determined by the parameters of the IC appearing in them. The calculated operating conditions of the microassembly are given and the advantages of such multipackage microassemblies are shown. Figures 1.

## MIXER BASED ON SCHOTTKY-BARRIER DIODE FOR SHORTWAVE PART OF MILLIMETER AND SUBMILLIMETER WAVE LENGTHS

Moscow RADIOTEKHNIKA I ELEKTRONIKA [Radio Engineering and Electronics] in Russian Vol 22, No 8, Aug 77 pp 1722-1724 manuscript received 27 May 76

AVERIN, S. V., and POPOV, V. A.

[Abstract] The results are presented of an experimental investigation of a mixer based on a Schottky-barrier diode (SBD), in the shortwave part of the millimeter and submillimeter band of wave lengths. Because quasi-optical channels are widely used in the submillimeter band of wave lengths for channeling radiation, a new type of mixing chamber was developed, which assures a good agreement with the radiation being received and a ready junction with quasi-optical channels. The mixing chamber is constructed so that it is free from critical alignment, is durable, resistant to vibration, and is readily joined with a quasi-optical channel or a receiving antenna. The investigations showed that use of the mixer assures good decoupling between the heterodyne and signal channels. The dependences is investigated of the conversion losses of the mixer on the frequency of the radiation received, the number of harmonics, and the power of the oscillator. A block diagram is presented of the equipment used for measurement of the conversion losses. A threshold sensitivity  $P_T \approx 10^{-10}$  w/Hz at a frequency of 280 GHz was experimentally obtained at room temperature. The authors thank M. M. Sharf for assistance in production of the mixing chamber. Figures 2; tables 1; references 7: 4 Russian, 3 Western.



USSR

UDC 528.516-182.73.089.6

FIELD TESTS OF THE 'LUCH' RADIO RANGE FINDER

Moscow GEODEZIYA I KARTOGRAFIYA [Geodesy and Cartography] in Russian Izd-vo "Nedra" No 6, Jun 77 pp 18-22

BAGRYANSKIY, L. L., VERNITSKIY, M. I., GENIKE, A. A., ZLOTIN, V. V., KULIN-CHENKO, A. A., MARKITESOV, S. V., NEZHDANOV, N. N. and ROTENBERG, B. I.

[Abstract] The paper gives the results of field tests of the "Luch" geodetic radio range finder made at the proving ground of TsNIIGAIK [Central Scientific-Research Institute of Geodesy, Aerial Surveying and Cartography] in May-June 1976 for an objective evaluation of the main metrological and operational characteristics of the instrument. Measurement stability and errors were checked for small displacements, at the upper end of the range, and at reduced supply voltage. The width of the radiation pattern was measured. The test results show the following technical data: range of action up to 40 km (production units have been successfully used for measuring ranges of up to 88 km); measurement accuracy ( $3 + 3 \cdot 10^{-6}R$ ) cm; height of elevation of remote transceivers up to 25 m; power consumption for a single station 70 W; line measurement times 8-10 minutes. Measurements and weights of the components of the range finder are given. Figures 3; tables 3.

USSR

THE 'SKALA' RADAR COMPLEX

Moscow RADIO in Russian No 6, Jun 77 pp 15-16 and unnumbered page opposite 16

RABINOVICH, G., candidate of technical sciences, and ELENTUKH, Z., candidate of technical sciences

[Abstract] The paper describes the "Skala" radar complex which serves as a basis for automated and non-automated Soviet air traffic control systems. The complex is a development and improvement of the "Utes" complex already described in this magazine. The radar has a scan zone formed by a vertical beam with angle of elevation from 30' to 45°, altitude of 20 km and range of 400 km. The accuracy of determining range coordinates is within 250 m, and the accuracy of determining azimuth coordinates is within 10'. The resolution is 650 m in range and 1.3° in azimuth. The rate of information renewal is 10 or 20 s. Stand-by equipment is provided for reliability. Pulse power of the primary radar is 3.6 MW, sensitivity of the receiver is 140 dB. The moving target indication system (MTI) is described. The display equipment operation in the control tower is discussed. Figures 5.

STUDY OF NOISE IMMUNITY ACHIEVED BY USING THE MODIFIED  $F_{\max}$  CRITERION FOR INHOMOGENEITY OF THE NOISE FIELD

Moscow RADIOTEKHNIKA [Radio Engineering] in Russian No 8, 1977 pp 18-23  
manuscript received after completion, 24 Jan 77

AGRANOVSKIY, K. YU., SOKOLOV, O. L., TURBOVICH, M. L., and FROLOV, V. M.

[Abstract] This paper discusses an algorithm for detecting a random normal signal against a background of noise of unknown strength. This algorithm consists in comparing with the threshold the logarithm of the ratio between the maximum and minimum sums of the squares of random signals formed in various regions of the noise field under study. Noise immunity associated with employing this algorithm is determined by Fischer's F distribution, and with more than two regions it is possible to use the modified criterion,  $F_{\max}$ . A determination is made of precise characteristics of noise immunity achieved when using the  $F_{\max}$  criterion. Detection characteristics for this criterion, which is based on the ratio between random dispersions, do not depend on the power of processes taking place, but only on the signal-to-noise ratio. A block diagram is shown for the equipment used to implement the algorithm described. From M points in the noise field random values of M random independent Gaussian centered processes with unknown but identical power enter M information channels. In each of these channels it is possible for an additional random signal to appear, which is also a Gaussian centered signal, against a noise background. To detect this signal, in each channel L random values are squared and added together in integrators. An extremizer selects the maximum and minimum from M of these sums,  $S_{\max}^2$  and  $S_{\min}^2$ , respectively.  $S_{\max}^2$  and  $S_{\min}^2$  are logarithmized,  $S_{\min}^2$  is inverted, and they are added along with computation of their ratio. The presence of a signal is determined by a threshold gate, when a certain threshold value,  $z_0$ , is exceeded by a magnitude of  $\log_n F_{\max} = \log_n (S_{\max}^2 / S_{\min}^2)$ . A study is made of probability densities of this criterion with inhomogeneity of the noise field. Characteristic curves are given for detection of noise field inhomogeneity, plotted with the formulas derived here. Comparison between these curves and curves from a previous study showed good agreement, although a different criterion was used in that study. It is concluded that employment of the criterion discussed here is simpler from the equipment standpoint. Figures 4; references 6: 4 Russian, 2 Western.

USSR

UDC 621.391.2

# TOP ACCURACY OF ESTIMATION OF DOT TARGET COORDINATES

Moscow RADIOTEKHNIKA I ELEKTRONIKA [Radio Engineering and Electronics] in Russian Vol 22, No 8, Aug 77 pp 1607-1611 manuscript received 23 Feb 76

KREMER, A. I., and TRIFONOV, A. P.

[Abstract] The tendency to an increase of the dimensions of antenna systems on the one hand, and the use in radar of increasingly shorter waves on the other leads to the fact that in many cases the target turns out to be in the Fresnel region of the receiving antennas. The literature contains a number of works concerned with space-time processing of signals in the Fresnel region. However, the problems considered in them deal with questions of resolution of targets and estimations of their location with reception by a linear one-dimensional antenna. The present paper is concerned with an analysis of the top accuracy of estimation of the coordinates of a target located at an arbitrary distance from a receiving antenna of any dimensions used in practice. A correlation matrix is found of the estimation of the coordinates of a target with space-time processing of the spherical wave which is received. The formulas obtained take into account the minor parameters of the signal and as a particular case include the known expressions for the top accuracy of estimation of the coordinates in the far region and in the Fresnel region. Figures 2; references: 7 Russian.

USSR

UDC 621.396.626

# POTENTIAL NOISE IMMUNITY OF SYSTEMS FOR RECEIVING PULSED WIDEBAND SIGNALS AGAINST A BACKGROUND OF SPECTRALLY CONCENTRATED INTERFERENCE AND QUASI-WHITE NOISE WITH TIME GATING

Moscow RADIOTEKHNIKA [Radio Engineering] in Russian No 8, 1977 pp 92-94 manuscript received 25 Mar 75; after completion, 17 Dec 75

GOYKHMEN, E. SH.

[Abstract] Time gating, whereby the receiving equipment is periodically triggered off for short intervals of time, is used in certain radar and radio navigation systems. Continuous noise with a concentrated spectrum is then subjected to modulation and is converted into pulsed interference, which has a considerable influence on the noise immunity of the equipment. It is most convenient to trace the influence of the effect of gating on noise immunity for cases when harmonic interference or concentrated noise interference with a square spectrum envelope and quasi-white noise are at work in the equipment's input. The present paper is devoted to this problem.

An estimate is made of the gain achieved in the signal over interference brought about by using in an optimum system a priori information regarding the interference spectrum. This gain is estimated by means of a factor derived in an earlier study and equals the ratio between the increase in the signal over interference at the output of the system and the increase achieved in directly processing a mixture of unconverted interference and the signal by means of a matched filter. An expression is found for this factor for the particular case studied here. A determination is made of the dependence of this factor on the ratio of the input power of quasi-white noise and concentrated interference, to determine the potential capabilities of methods of noise protection based on using a priori information on the interference spectrum under specific interference conditions. Formulas are obtained which make it possible, taking into account the effects brought about by gating, to estimate the dependence of the gain in noise immunity, resulting from using information on the form of the envelope of the concentrated interference spectrum, on the ratio between the input power of this interference and that of the noise. Analysis of the results obtained indicates that when time gating is employed, the use of the equipment considered here for protection from spectrally concentrated interference is feasible only when its level is much higher than the level of quasi-white noise (by approximately 15 to 30 dB). When the factor expressing the degree of accumulation of noise during the gating interval equals 10 and more, it is possible to suppress spectrally concentrated interference by 15 to 25 dB. Figures 2; references: 3 Russian.

## Receivers and Transmitters

USSR

### NEW DESIGNS OF BROADCAST RECEIVERS

Moscow RADIO in Russian No 8, 1977 pp 36-39

KRESTOVSKIY, S., engineer, Leningrad

[Abstract] At present, native development is completed on an electronic analog of a variable capacitor--a matrix consisting of three varicaps--and it has been placed in a project for promising models of broad receivers. Use of varicaps and varicap matrices makes possible electronic automatic control of tuning. Another constructional unit, which has begun to be displaced from broadcast receivers, is the mechanical switch. Use of tuning by varicaps in the ultrashort wave band lead to the appearance of models of household equipment with sensory switching for fixed tuning. A block diagram is shown of one of the possible variations of an all-wave monophonic radio receiver of the first class, with electronic tuning, sensory switching of the bands and control of auxiliary operations (inclusion of AFC, quiet tuning, switching of magnetic and electrical antennas). An overall view is shown of a laboratory model of the receiver. (The external loudspeaker is not included in the photograph.) A test of the creation of a laboratory model of an all-wave broadcast receiver with electronic tuning and sensory switching showed that development and industrial output is possible of native radio-photograph and radio-tape recorders (which do not have analogs at present) and that they will be highly reliable and convenient in operation. Figures 2.

USSR

UDC 621.382.28.001.5

NONLINEAR RESONANCE IN CIRCUIT WITH MOS VARACTOR

Moscow RADIOTEKHNIKA I ELEKTRONIKA [Radio Engineering and Electronics] in Russian Vol 22, No 8, Aug 77 pp 1623-1630 manuscript received 12 May 76

MARCHENKO, V. F.

[Abstract] It is known that a change of the average capacitance in a resonance system can survive the appearance in a circuit of an instability of the type of amplitude and phase discontinuities of the voltage which originates in the case of a change of the amplitude or frequency of the exciting voltage. From this point of view, an investigation of resonance phenomena in a circuit with a MOS-varactor is of interest for evaluation of the dynamic range of tunable circuits and phase shifters, independent of the use of the trigger effect in logic circuits. The present work presents a calculation of the resonance curves of a circuit with a MOS-varactor, the volt-farad characteristics of which are approximated by a piecewise linear function. Varactors on the base of the structure  $\text{Al-SiO}_2 \cdot \text{Si}_3\text{N}_4 - \text{Si-Al}$  were used in the work. The threshold amplitude which corresponds with the formation (disappearance) of instability of the amplitude and phase of the oscillations in the circuit with a slow change of the frequency of the external sinusoidal exciting voltage is evaluated. Experimental curves for three fixed frequencies are obtained, characteristic of various conditions of instability of the oscillations in a nonlinear circuit with a MOS-varactor, and the theoretical and experimental data are compared. It is shown that a quantitative evaluation of the divergence of theoretical and experimental data caused by both the roughness of the piecewise linear approximation and the physical processes in a MOS structure which distorts the course of the  $C(V)$  curve can only be obtained by taking into account the peculiarities of a specific specimen of a varactor. Figures 6; tables 1; references 7: 6 Russian, 1 Western.

USSR

UDC 621.392.233.011.222.072.1

INHOMOGENEOUS RELAXATION OF THE SURPLUS CHARGE IN THE WIDE BASE OF  
THYRISTORS WITH ELEVATION RECOMBINATION REGIONS DURING TURN-OFF

Moscow RADIOTEKHNIKA I ELEKTRONIKA [Radio Engineering and Electronics] in Russian Vol 22, No 8, Aug 77 pp 1755-1758 manuscript received 9 Feb 76

GORBATYUK, A. V., and UVAROV, A. I.

[Abstract] As shown in the literature, turn-off of power thyristors with elevated recombination regions (ERR), as a consequence of the flow of large

tangential currents, must be accomplished by a significant transverse redistribution of charge in the wide base, which leads to a necessity for taking account of the tangential effects. In the present short communication, the results of calculations illustrate the strong nonuniformity of the density of the surplus charge with respect to the radius. (A graph is shown of the transverse distribution of surplus charge in the n-base of a thyristor at various moments of time.) A graph is also presented of the dependence of the turn-off time of the thyristor structure on a distance between ERR, equal to the doubled radius of an elementary thyristor region. (Curves are shown: 1) For an ordinary structure; 2) According to a quasi-one-dimensional model; and 3) According to a proposed model.) From the graph it is seen  $t_{\text{turn-off}}$  calculated according to the proposed model reveals a very weak dependence on R and an approximately equal time of turn-off with respect to the estimate of the quasi-one-dimensional theory. It is possible to explain the rapid closing up of the region of elevated density of the charge, because the rate of movement of the boundary is determined by the fairly short time of flight of the holes through the n-base. Figures 3; references 4: 3 Russian, 1 Western.

USSR

UDC 681.382.001.5

# CALCULATION OF THE SURFACE POTENTIAL AND FIELD FOR A TWO-DIMENSIONAL MODEL OF A TWO-PHASE DEVICE WITH CHARGE COUPLING

Moscow RADIOTEKHNIKA I ELEKTRONIKA [Radio Engineering and Electronics] in Russian Vol 22, No 8, Aug 77 pp 1752-1754 manuscript received 22 Mar 76

LABUDEV, V. N.

[Abstract] In order to study the operation of a device with charge coupling (DCC) it is necessary to know the distribution of the surface field, which it is possible to obtain on the basis of an analysis of a two-dimensional structure. In the literature, such an analysis has only been conducted for a three-phase DCC. The present short communication presents a method of calculating the distribution of surface fields for a two-phase DCC, and a calculation of the surface potential and field for typical parameters of a device is used to illustrate the method. Figures 2; references 3: 1 Russian, 2 Western.

USSR

#### ELECTROLUMINESCENT DISPLAYS

Moscow RADIO in Russian No 7, 1977 p 48 and following unnumbered full-page drawing

LISITSYN, B., Moscow

[Abstract] A simplified description is given of the construction and operation of electroluminescent displays, including the alphanumeric, mnemonic, symbol, matrix and mosaic types, as well as displays with representation visible or concealed in an inactive state. Drawings in color are presented of various aspects of the displays. Figures 6.

USSR

UDC [621.315.61:535.683].001.24

#### STUDY OF THE CONDUCTIVITY OF IRRADIATED DIELECTRICS

Moscow ELEKTROTEKHNIKA [Electrical Engineering] in Russian No 8, 1977 pp 49-51

MASLOV, V. V., candidate in technical sciences, IVANOV, N. V., and SHELENIN, A. V., engineers

[Abstract] The processes of ionization of air, metals and dielectrics arising from Gamma irradiation are analyzed. The effect of these processes on the measurement of the electrical conductivity of the dielectrics which are irradiated is evaluated. The maximum current which can be carried by an ionized gas is proportional to the radiation dose, gas pressure and reciprocal gas temperature. It is much more difficult to define the voltage developing between the two metal objects exposed to ionizing radiation due to such factors as the variation in resistance with dose, difficulty in defining the coefficient characterizing the accumulated charge, which depends on the nature of the metal, its shape, thickness and many other factors. Results of a simple calculation are presented in tabular form for aluminum. In some cases the voltage which develops is proportional to dose, in other cases -- to the square root of dose, in still other cases -- somewhere in between. Tables 3; references 6: 5 Russian, 1 Western.



USSR

UDC 533.09

## RESONANCE PROPERTIES OF AN INHOMOGENEOUS PLASMA COLUMN

Gor'kiy IZV.VUZ:RADIOFIZIKA [Bulletin of Higher Educational Institutions: Radiophysics] in Russian Vol 20, No 6, 1977 pp 932-938 manuscript received 22 Jan 76

BAZHANOV, V. S., ISAYEV, V. A. and MARKOV, G. A., Scientific-Research Radiophysics Institute

[Abstract] This paper gives the results of an experimental study of the influence of broad boundaries for the plasma, and of low-threshold nonlinear effects associated with distortion of the distribution of electron density in a space of velocities and coordinates, on the resonance properties of a plasma column. As the result of the breadth of the plasma's boundary and an increase in attenuation of longitudinal waves at the periphery associated with this, the column's spectrum of natural high-frequency oscillations is considerably depleted. With an increase in the power of a microwave probing the plasma over a certain threshold level (approximately 0.3 W), a pronounced increase in relative absorption is observed at resonance frequencies, as well as the appearance of a new resonance peak (with power of the probing microwave greater than 2.5 W). The presence of dipole resonances of a quasistatic and plasma wave nature in the high-frequency oscillation spectrum of an inhomogeneous plasma column which is thin in comparison with the wavelength of the exciting field was demonstrated in an earlier study. It was also demonstrated previously that the width of resonance lines with sufficiently low frequencies of electron collision is determined by Landau attenuation and depends considerably on the nature of the plasma's density distribution in the inhomogeneous segment. In the experiments described here an analysis was made of the high-frequency oscillation spectrum of an inhomogeneous plasma column by studying resonance absorption of a  $TE_{01}$  wave from a rectangular waveguide by a positive gas discharge column intersecting the waveguide parallel to its narrow walls. The waveguide was shorted with a metal plunger at a distance of one-quarter wavelength beyond the discharge tube. Discharge took place in helium. Variation of the density distribution of the plasma with respect to the column's radius was accomplished by varying the pressure of the gas and the radius of the discharge tube and was monitored according to the transverse distribution of the discharge current, read by means of a sectional anode. Glass tubes were used and 50 Hz alternating voltage was supplied to the tube's anode with 2 kV maximum. The power of the probing signal could be varied from single-number milliwatts to 20 W. Resonances were observed in the form of absorption peaks on oscillograms showing the relationship between the high-frequency power absorbed by the column and the discharge current. Oscillograms are shown and discussed in detail. With power of the probing signal greater than 2.5 W power versus current oscillograms show a new absorption peak which is associated either with pumping of the energy of the incident wave into a surface wave of the dipole type, or with nonlinear deformation of the spatial distribution of the

plasma's density in the plasma resonance region and with excitation of standing plasma waves in this region. The results given here offer a new experimental proof of the collision-free attenuation theory and show that it is possible to control the high-frequency properties of inhomogeneous plasma units by means of a microwave signal probing the plasma. The author thanks V. B. Gil'denburg for valuable council and comments. Figures 7; references 13: 6 Russian, 7 Western.

USSR

UDC 537.213.001.24

#### ON CALCULATING PLANE-PARALLEL FIELDS IN ANISTROPIC MEDIA

Moscow ELEKTRICHESTVO [Electricity] in Russian No 8, 1977 pp 64-67  
manuscript received 19 Nov 76

KNYAZ', A. I., dr in technical sciences, Odessa

[Abstract] Investigations of stationary electromagnetic fields in piecewise-homogeneous media with the presence of anisotropy in one of the media have been shown to be of great practical interest. The most fruitful is the formulation of the problem of calculation with the aid of integral equations which are solved by numerical methods. In the present paper the problem is set so that in a number of cases it is possible to obtain its solution in an analytical form with a sufficiently arbitrary type of boundary. In contrast to a previous work cited in the literature, the more general case of anisotropy is also considered. Simultaneous consideration of the electrical and magnetic problems creates a needed economy of space. An algorithm is proposed, based on the use of complex coordinate functions. Figures 3; references: 8 Russian.

USSR

UDC 538.56:530.145

#### ATTENUATION OF $2\pi$ -PULSES IN A TWO-LEVEL MEDIUM

Gor'kiy IZV.VUZ:RADIOFIZIKA [Bulletin of Higher Educational Institutions: Radiophysics] in Russian Vol 20, No 7, Jul 77 pp 1109-1112 manuscript received 16 Feb 76

GORSHKOV, K. A., PELINOVSKIY, YE. N., and SHAVRATSKIY, S. KH. Scientific-Research Institute of Radiophysics

[Abstract] In connection with experimental and theoretical studies concerning the propagation of ultrashort pulses through an active medium, the

attenuation of a  $2\pi$ -pulse is analyzed for the case where the total line width depends only on the characteristic time of transverse relaxation. In a ruby, for instance, this situation prevails already at liquid-nitrogen temperatures. The fundamental system of equations for the envelopes is written on the basis of exact resonance (carrier frequency equal to the center frequency of the uniformly widening line) and solved in the first approximation by the method of a small parameter. The result yields corrections to the quasi-steady solution as well as the boundedness constraints on the field intensity, the polarization, and the density of inverse occupancy. The equation of energy balance in the electric field indicates that linear losses are significant at high energy levels and polarization relaxation is significant at low energy levels, both becoming equally significant at a pulse energy of about 50 J. The attenuation characteristic is calculated on this basis. The authors thank V. I. Bespalov for useful discussions.

USSR

UDC 621.391.2

# ON THE NUMBER OF LEVEL CROSSINGS OF A STATIONARY RANDOM PROCESS WITH A DISTRIBUTION DIFFERING FROM THE GAUSSIAN

Moscow RADIOTEKHNIKA I ELEKTRONIKA [Radio Engineering and Electronics] in Russian Vol 22, No 8, Aug 77 pp 1737-1739 manuscript received 22 Dec 75; after revision, 10 Feb 77

KHIMENKO, V. I.

[Abstract] The results of this work make it possible in many problems to determine the average number of level crossings without preliminary determination of the simultaneous probability density, as well as make it possible to characterize the effect of the parameters of the form of a one-dimensional probability density and the effect of nonlinear coupling between the values of the stationary random process and its derivative on the statistical characteristics of the level crossings of the processes in question. The conclusions of the work allow further generalizations, and taking account of the results of a previous work by the author [Izv. VUZ. MVSSO SSSR (Radiofizika) 1976, 19, 8, 1188], make it possible to establish a simple connection between the spectral-correlation properties and the properties of the level intersections, by the trajectories of stationary processes. The author thanks V. I. Tikhonov for helpful critical remarks. References: 4 Russian.

## SPATIAL RESOLUTION OF THE THERMAL METHOD OF RECORDING MODULATED RADIATION FLUX BASED ON FILM STRUCTURES

Gor'kiy IZV.VUZ:RADIOFIZIKA [Bulletin of Higher Educational Institutions: Radiophysics] in Russian Vol 20, No 6, 1977 pp 924-931 manuscript received 26 Mar 76

VLASOV, B. I., Voronezh State University

[Abstract] This paper analyzes the spatial resolution of the thermal method of recording employing registration of temperature reliefs, versus the thermophysical parameters of metal-semiconductor film structures and the frequency of flux modulation. The thermal method of recording with metal-semiconductor film structures is now used extensively for studying the spatial distribution of the power flux of microwave and IR radiation when adjusting and tuning equipment, in studying the mode structure of laser emission, in obtaining microwave holograms, and in visualization of radio images. The temperature relief along the metal-semiconductor structure arising under the effect of radiation results in local extinguishing of a luminophor or in altering gating in the semiconductor film, which is observed as a bright thermal image of the flux's cross section or is recorded in a memory by means of film-type temperature-sensitive elements. Deviation of the temperature relief (and of the transmittance relief when effects in the semiconductor are linearly dependent on temperature) from the current density distribution law is determined by the finite value of the metal-semiconductor structure's thermal conductivity. A theoretical examination is made of the influence of radiation flux modulated over time with a meander line with a specific repetition frequency on a metal-semiconductor structure. The spatial distribution of the flux in a two-dimensional space is in the form of infinite bands (a Foucault universe) of equal width which are uniformly exposed and unexposed. A formula is presented for the intensity of release of heat energy per unit of volume of the metal-semiconductor structure with specific thermophysical parameters. A formula is derived which described the spatial distribution of temperature in the film structure in the form of the sum of reliefs pulsating and not pulsating at the specific repetition frequency mentioned above. Experimental studies were made, using a metal-semiconductor structure consisting of a mica substrate sprayed with a nichrome film, which absorbs microwave radiation, to determine the spatial resolution of the thermal method of recording modulated radiation flux by registering a pulsating temperature relief. Both theoretical and experimental studies demonstrate that the number of resolvable lines increases monotonically with an increase in modulation frequency. It is demonstrated that it is possible to estimate standard thermophysical parameters of film-type structures for variations in UHF emission. Figures 3; references: 8 Russian.

## CALCULATING FIELDS OF MAGNETIC HEADS BY THE HUYGENS-KIRCHHOFF METHOD

Moscow RADIOTEKHNIKA [Radio Engineering] in Russian No 8, 1977 pp 89-91  
manuscript received 5 Mar 75; after completion, 29 Dec 75

KOROLEV, YE. F.

[Abstract] This paper gives the results of calculating a three-dimensional field, taking into account finite values of the magnetic constant and the length of the pole tips of magnetic heads, obtained on the basis of the Huygens-Kirchhoff analytical method described in an earlier paper by this writer. The use of promising thin-film highly coercive carriers such as magnetic disks and metal-coated tapes makes it necessary to take into account the influence of the magnetic constant on distribution of the field in the vicinity of the working gap of magnetic heads. A three-dimensional model of a magnetic head with pole tips of finite length is considered. The ratio of the density of electric currents on the surface of the gap to the density of electric currents on the surface of the core (pole tips) is inversely proportional to the ratio between the magnetic constant of the materials of the gap and that of the pole tips. Formulas are derived for magnetic field components. It is assumed that the magnetic constant of the material filling the working gap of the heads equals unity. Formulas are obtained for a two-dimensional magnetic field; when the relative magnetic constant of the core material (pole tips) approaches infinity, these formulas are transformed into Karlkvist's formulas (1967) and are generalizations of these formulas for the specific case here. The results are given of a calculation of the horizontal component of the magnetic field of heads as defined here with several values of the magnetic constant for pole tips. Reduction in this constant to values of 100 and more does not show a considerable influence on the distribution of the horizontal component and, thus, on the major quality ratings of magnetic recording systems. However, further reduction can worsen these characteristics substantially. As the constant approaches unity there is a continuous expansion of the effective gap, which becomes equal to the length of the pole tips when the constant equals unity. The results obtained here explain well the experimental data published in an earlier study (Lazzari and Wade, 1971) and based on measuring stray fields of integrated and ferrite magnetic heads by methods of electron microscopy. The method used here makes it possible to obtain relatively simple analytical expressions for the components of three-dimensional and two-dimensional fields of magnetic heads, taking into account finite values of the magnetic constant and length of the pole tips. Figures 2; references 9: 8 Russian, 1 Western.

USSR

UDC 62-501.12

METHODS OF IDENTIFYING THE PARAMETERS OF LINEAR DYNAMIC OBJECTS SUBMERGED  
IN NOISE

Moscow IZVESTIYA AKADEMII NAUK SSSR, TEKHNICHESKAYA KIBERNETIKA [Bulletin  
of the Academy of Sciences, USSR, Technical Cybernetics] in Russian No 4,  
Jul-Aug 77 pp 209-216 manuscript received 2 Oct 75

SHUBLADZE, A. M., Moscow

[Abstract] Noise-immune methods of identifying a linear object under normal  
operating conditions are proposed, to apply when the observable signals  
contain noise. These methods are based on theorems of exponential stability,  
first for the case of noisy input signals, then for noisy output signals,  
and finally for both noisy signals. A rigorous proof of the first theorem  
is given, the other two being proven analogously. References 7: 6 Russian,  
1 Western.

USSR

UDC 621.3.032.269.1

SYNTHESIS OF ELECTROSTATIC ELECTRON GUN WITH A LARGE-STRUCTURE  
CONTROL GRID

Moscow RADIOTEKHNIKA I ELEKTRONIKA [Radio Engineering and Electronics] in  
Russian Vol 22, No 8, Aug 77 pp 1706-1717 manuscript received 23 Jul 76

DANILOV, V. N. [Deceased], and DROZDOV, S. S.

[Abstract] The work is concerned with a calculation and optimization in a nominal regime, of the design of a gun with shadow and large-structure control grids. Various methods for control of the beam are considered in the literature as well as experimental work in which good results were obtained for a gun which contains large-structure shadow and control grids located above a porous cathode. The design described served as the basic concept of the method of calculation proposed in the present paper, which consists first of all of the fact that, on the basis of a paraxial approximation, a macrogun is synthesized with the inherent values of the potential, the field intensity, and the current density prescribed for an ideal grid in a nominal regime. Subsequently, also on the basis of a paraxial approximation (in a system of coordinates connected with the axis of macrobeam), a standard microgun is synthesized, which assures an average value of the parameters specified in an ideal grid, during which the cathode, the zero focusing electrode and the anode of the microgun form, respectively, the cells of the cathode, and the shadow and control grids, which have a common axis of local symmetry. These cells are united farther into a honeycomb design, and subsequently, now in terms of analysis, a calculation can be made of the boundaries of the macrobeams spreading into the regions beyond the control grid. In a latter problem it is necessary to take into account the mutual effect of microbeams resulting from the Coulomb forces of the space charge. It is shown that regardless of the presence of large-structure grids, the beam which is formed in a nominal regime can maintain on the average a laminar microstructure and a laminar structure throughout the accelerating gap of a macrogun, and an increase of the aperture of the beam because of perturbation introduced by the grids is small. The authors thank P. V. Nevskiy for stimulation of the investigations. Figures 4; references 7: 6 Russian, 1 Western (translated).

USSR

UDC 621.395.623.5.001.5

ON THE MECHANISM OF MICROWAVE SIGNAL DETECTION IN ELECTRON DEVICES OF  
THE REFLEX KLYSTRON TYPE

Moscow RADIOTEKHNIKA I ELEKTRONIKA [Radio Engineering and Electronics] in  
Russian Vol 22, No 8, Aug 77 pp 1673-1679 manuscript received 26 May 76

KUZNETSOV, V. L.

[Abstract] It has been shown in a number of experimental works that an electron flow with a virtual cathode within it can be used with high efficiency during detection of high-frequency signals. Two approaches to the problem are outlined. The present work considers the mechanism of detection of a high-frequency signal in electron devices where an electron flow modulated in advance enters into the space of a reflector (a modified diode) with a virtual cathode within it. The effect of the perturbation of the electron flow on the static characteristic of a modified diode is examined. The solution of the overall problem takes into account a change of the magnitude of the virtual cathode and its transfer in interelectrode space. It is shown that just these phenomena also determine the magnitude of the detector current. The author thanks G. Ya. Myakishev for guidance of the work. Figures 2; references: 13 Russian.



USSR

UDC 537.222.001.24

NEUTRALIZATION OF THE CHARGE ON A MOVING FILAMENT BY MEANS OF A  
CYLINDRICAL RADIOACTIVE NEUTRALIZER OF STATIC ELECTRICITY

Moscow ELEKTRICHESTVO [Electricity] in Russian No 8, 1977 pp 78-81  
manuscript received 19 Sep 75

SLYSHALOV, V. K., KROMOVA, N. A., SHIKOVA, I. YE. and GEFTER, P. L.

[Abstract] Cylindrical radioactive neutralizers, increasingly used as an efficient means of decreasing the charge densities of static electricity on fibers and filaments, are considered, in particular the case of "long" neutralizers. The investigation is conducted by the methods of approximate mathematical modeling, allowing for the principal factors affecting the neutralization process. Graphs are shown of the distribution of charge density and the potential along a moving dielectric filament, and the "input-output" characteristics of a cylindrical neutralizer in the case of various rates of movement of the filament. On a basis of the method considered, problems of optimization of the process of neutralization of charges on a dielectric filament can be solved, requiring checking of a large number of variations. The possibilities are considered of a test by calculations of designs of neutralizers and schemes for their distribution in production. Figures 3; references: 5 Russian.

USSR

UDC 621.311.6:621.382.82

POWER SUPPLIES FOR INTEGRATED MICROCIRCUITS

Moscow PRIBORY I SISTEMY UPRAVLENIYA [Control Devices and Systems] in Russian No 7, Jul 77 pp 36-37

PROVAL'SKIY, R. P., YEGOROVA, T. I. and GOVYAZO, YU. M., engineer

[Abstract] A few special-purpose heavy-duty power supplies for integrated microcircuits in radio engineering systems are shown, which feature a complete standardization of components and excellent electrical performance characteristics. Three of them are rated for 0-3 A at 5 V, 0-1 A at 6.3 V, and 0-1 A at 12.6 V respectively. The output voltage varies typically by not more than 0.05 percent due to  $\pm 10$  percent fluctuations of the line voltage,  $\pm 50^\circ\text{C}$  fluctuations of the ambient temperature, and over the 10-100 percent load range. Figures 3; tables 1.

USSR

UDC [621.313.12:621.3.048.3].001.4

TESTING OF THE INSULATION OF STATOR WINDINGS OF HIGH VOLTAGE, HIGH POWER  
ELECTRIC MACHINES WITH 0.1 HZ EXTRA LOW FREQUENCY VOLTAGE

Moscow ELEKTROTEKHNIKA [Electric Engineering] in Russian No 6, Jun 77 pp  
27-30

ALEKSEYEV, S. A. and IVATSIK, YE. YE., engineers, KOZYREV, N. A., candidate  
of technical sciences, and MINCHENKO, L. S., engineer

[Abstract] The results of comparative testing of thermosetting insulation at extral low and standard line frequencies have shown that a frequency of 0.1 Hz is approximately as effective in testing as 50 Hz. However, the extra low frequency voltage has higher selectivity (greater difference between indicators produced in testing good and effective products) than standard line frequency voltage. The insulation tested also ages less when tested at high voltages at extra low frequency. The results are not as yet sufficient to make a final decision as to which frequency is preferable for testing of large, high power motors, but the lower wear rate of insulation and semiconductor devices indicate that low frequency testing should continue to be studied as a possibility. Figures 2; tables 2; references 4: 2 Russian, 2 Western.

USSR

UDC 621.313.13-181.4

EFFECT OF VARNISH FILMS ON THE STABILITY OF THE STARTING CHARACTERISTICS OF  
ELECTRIC MICROMOTORS

Moscow ELEKTROTEKHNIKA [Electrical Engineering] in Russian No 7, Jul 77  
pp 34-36

BELYY, V. A., dr in technical sciences; KONCHITS, V. V., engineer, MESHKOV,  
V. V., engineer, and SAVKIN, V. G., candidate in technical sciences

[Abstract] The brushes-and-commutator system of d-c micromotors for automatic controls and servomechanisms must retain very stable electrical and frictional characteristics under all possible operating and storage conditions. Of particular concern, for instance, are the effect of high temperature and humidity on the starting characteristics of such micromotors. An experimental study was made on two batches, one batch of 10 with metal-resin brushes and one batch of 8 with copper-graphite brushes. Environmental tests and performance measurements have shown that, although copper-graphite brushes do not adequately protect the surface of a copper commutator against oxidation, metal-resin brushes form a film of high electrical conductivity

and corrosion resistance which ensures stable motor operation after exposure to  $40 \pm 2^\circ\text{C}$  and  $90 \pm 5\%$  humidity. Figures 3; tables 1; references 8: 7 Russian, 1 Western.

USSR

UDC 621.313.333-181.4.002.2

TRENDS IN THE DEVELOPMENT OF INTEGRATED TECHNOLOGY FOR THE MANUFACTURE OF  
FACE-TYPE INDUCTION MICROMOTORS

Moscow ELEKTROTEKHNIKA [Electrical Engineering] in Russian No 6, Jan 77 pp  
18-20

IGNATOV, V. A., dr in technical sciences

[Abstract] Face-type (rather than concentric) induction motors are manufactured by methods of integrated circuit technology, have an axial air gap and the active zone is distributed over a circular area. This allows these machines to be made flat, and built into various devices. The functional precision of these machines can be improved by improving the design of windings by making a transition to multilayer and multiphase windings, by using windings with a variable step, for example, to compensate for the edge effect, by using nonius [vernier] principles and by certain combined solutions, as well as by increasing the accuracy of manufacture of the windings themselves. Either printed or stamped windings can be used, as well as windings made by vacuum atomization, laser techniques and certain other progressive technologies. For motors used in domestic electric appliances, for example, it is desirable to use stamped windings and cores, pressed of inexpensive magnetic powder materials. The technologies involved in the manufacture of such motors are discussed. Difficulties are encountered in maintaining separation and quality of manufacture of individual elements as the process of miniaturization continues. Figures 2; references: 9 Russian.

USSR

UDC [621.313.333+621.313.323]-185.3.001.2

LINEAR ELECTRIC AC MOTORS FOR PRODUCTION MECHANISMS AND AUTOMATIC DEVICES

Moscow ELEKTROTEKHNIKA [Electrical Engineering] in Russian No 6, Jun 77 pp  
12-15

VESELOVSKIY, O. N., candidate in technical sciences

[Abstract] If a linear induction motor is constructed according to the "standard" scheme, with the stator of a rotating motor simply extended in

a line and surrounded by a moving "rotor," it is difficult to make the parts of the motor small enough to permit low operating velocities, such as those needed in intershop transport, to be achieved. The Novosibirsk Electrical Engineering Institute has been studying the possibility of using a new structure involving continuous alternation of layers of copper winding and ferromagnetic layers with the alternating structures consisting of a single layer of steel and a single layer of conductors. These structures are placed perpendicular to the direction of movement of the linear motor, allowing the pole separations to be very small, which can produce linear motors operating efficiently at much lower speeds. Figures 5; references 7: 6 Russian, 1 Western.

USSR

UDC 621.313.333:62-213.34.001.3

ANALYSIS OF EXPLOSION-PROOF MOTORS RATED FROM 7.5 TO 55 kW

Moscow ELEKTROTEKHNIKA in Russian No 7, Jul 77 pp 58-61

GORYAGIN, V. F., candidate in technical sciences; ZBARSKAYA, E. R., ZINCHENKO, S. D., MAKAROV, K. D. and YURINSKAYA, S. V., engineers

[Abstract] A comparative design analysis is made of a new line of explosion-proof motors, mainly for mining applications, built in accordance with CMEA and IEC standards so as to qualify them for sale on foreign markets. The new V and VR series replace the old VAO, KO, KOF, and MA 36 series. The sizes range from 160 to 225 mm shaft height, from 291 to 393 mm stator OD, and from 170 to 280 mm stator stack length. The power rating varies, accordingly, from 7.5 kW at 1000 rpm (synchronous) for the smallest model to 55 kW at 3000 rpm (synchronous) for the largest model. The laminations are made of grade E1300 cold-rolled steel and the windings have Class H glass-film "imidiflex" insulation. The stators are skewed by one slot pitch and the rotors have double squirrel cages. The basic nominal dimensions and performance parameters are tabulated, the basic application and performance categories are defined. Figures 4; tables 4; references: 7 Russian

USSR

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EFFECT OF THE MAGNETIC ANISOTROPY OF ELECTRICAL-GRADE STEELS ON THE  
PERFORMANCE CHARACTERISTICS OF INDUCTION MOTORS

Moscow ELEKTROTEKHNIKA in Russian No 7, Jul 77 pp 42-43

SOLOMAKHIN, D. V., candidate in technical sciences, and BOYKO, YE. P.,  
engineer

[Abstract] With the anisotropy of magnetic induction and of losses in grades E330 and E0300 electrical sheet steel known, the effect of lamination stacking on the magnetic anisotropy of a stator core and then the effect of magnetic anisotropy on the performance of model 4A180M4 induction motors were measured. Data on the flux distribution around the airgap and on the motor performance characteristics (starting, full-load, and no-load) indicate that, while the magnetic anisotropy hardly affects the performance of motors stacked with grade E0300 steel, it decreases the efficiency of motors stacked with grade E300 steel by 1 percent. Figures 4; tables 1; references: 3 Russian.

USSR

UDC 621.315.2.001.4

STUDY OF THE COMPATIBILITY OF IMPREGNATING COMPOUNDS WITH ENAMEL WIRES

Moscow ELEKTROTEKHNIKA [Electrical Engineering] in Russian No 8, 1977 pp  
47-49

GALUSHKO, A. I., candidate in technical sciences, OSNACH, R. G., SOROKIN,  
YU. V. and KARPOVA, V. P.

[Abstract] This work reflects the results of a study of the compatibility of a number of prospective and widely-used impregnating compounds with enamel wire. Compatibility refers to the capability of the compounds and the enamel wire in a combined system to meet the requirements placed on the insulation of windings. The formation of defects and their development was tested by microscopic analysis of the structure of the insulation between turns. Breakdown voltage of the insulation was determined using specimens approximately reproducing the deformed stress state of monolithic or honeycomb systems. The interaction of the saturating compound with the enamel wire was quantitatively evaluated using a compatibility indicator  $\beta$ , equal to the ratio of breakdown voltage of saturated and unsaturated specimens. Judging from the results of testing, the compatibility of compounds with enamel wire depends to a great extent on the microstructure of the insulation. In particular, saturation with a rigid compound for honeycomb systems yields a higher index of compatibility than for

monolithic systems. Consequently, in the windings of machines saturated with these compounds, a honeycomb system may have advantages over a monolithic system. Figures 2; references 7: 6 Russian, 1 Western.

USSR

UDC 621.316.542.066.6:537.525.5

#### BEHAVIOR IN A VACUUM OF AN ARC ACROSS CONTACTS OF HETEROGENEOUS MATERIALS

Moscow ELEKTRICHESTVO [Electricity] in Russian No 8, 1977 pp 44-48 manuscript received 15 Jul 76

BELKIN, G. S., DANILOV, M. YE., LUKATSKAYA, I. A., and PEROV, V. V., All-Union Electrotechnical Institute imeni V. I. Lenin

[Abstract] In the case of the use of heterogeneous materials (produced by the methods of power metallurgy, multiphase alloys, and others) in contacts, inhomogeneities of two types occur: in a direction along the surface and in a direction normal to the surface of the contacts. During this the structural inhomogeneities at the surface of the contact are determined, not only by the technology for production of the material, but also by the operating conditions of the vacuum chamber. During arcing, transfer of metal from one contact to the other takes place, which forms metallic layers of the connections with difference physical properties. In addition, a transfer of metal occurs because of cold welding in the vacuum. The present paper is concerned with identification of the peculiarities of an arc in a vacuum with the presence of inhomogeneities of a different type which occurs in the course of use of contacts of heterogeneous material or unlike contacts. During arcing and even during preparation of contacts, films are formed on the surface, distorting the original structure. On the other hand, with the presence of a film on an especially made substrate, it is impossible to eliminate inhomogeneities of the first type because of burning-through of the film by the arc, and the appearance of spots beyond the boundaries of the deposited regions. Consequently, the investigations were conducted under conditions close to those which occur in a vacuum arc blowout chamber, i.e., with the presence of inhomogeneities of both types. An experimental investigation was made of the effect of structural inhomogeneities on the parameters of vacuum arcs, and the following characteristics were determined: voltage of arcing in a vacuum, equivalent voltage drops adjacent to electrode, cutoff currents, and electrowear, cutting off the capability of the contacts. Contacts of tungsten, molybdenum, copper, and iron were used, as well as materials based on tungsten, molybdenum and iron. The results are presented of a theoretical analysis of the processes of heat propagation in the heterogeneous materials and in thin films. Figures 3; tables 4; references 4: 3 Russian, 1 Western.

USSR

UDC 621.316.722.1

## USE OF MICROCIRCUITS IN VOLTAGE AND CURRENT STABILIZERS

Moscow PRIBORY I SISTEMY UPRAVLENIYA [Control Devices and Systems] in Russian No 7, Jul 77 pp 34-36

SIUKAYEV, A. V., candidate in technical sciences, BELOKON', V. N. and KRAVETS, G. V., engineers

[Abstract] An improved voltage stabilizer is shown whose operating range extends from zero to several thousand volts and which, by means of an external feedback connection, can be converted to a current stabilizer. Its high-voltage stage consists of a divider formed by a resistance and an active current-limiting element, an operational amplifier built on microcircuits, a regulator built on a transistor, and solid-state stabilized parametric power supply. Its performance as a voltage stabilizer and as a current stabilizer is analyzed here on the basis of circuit relations and design data. It requires only a low-capacitance filter or even no filter on the output end, but it does not have full compensation of thermal instability. Figures 2; tables 3; references: 16 Russian.

USSR

UDC 621.316.925:621.318.57

## ANALYSIS OF THE CHARACTERISTICS OF A MEASURING RELAY UNIT EMPLOYING AN OPERATIONAL AMPLIFIER IN AN INTEGRATED DESIGN

Moscow ELEKTRICHESTVO [Electricity] in Russian No 8, 1977 pp 68-71  
manuscript received 26 Jan 77

GRECHUKHIN, V. N., engineer, and TARSHIS, A. S., candidate in technical sciences, Energoset'proyekt [All-Union State Planning, Surveying and Scientific-Research Institute of Power Systems and Electric Power Networks], Gor'kiy

[Abstract] It has been shown that use of microcircuits makes it possible to obtain better characteristics of protective relaying with a simultaneous decrease of requirements with respect to the input circuits and the dimensions of the devices. A measuring relay unit (RU) is a converter of a constant control signal into a discrete controlling effect and in many respects determines the characteristics of protection. Better and more stable characteristics can be attained with fulfillment of the PU on the basis of an amplifier with a high amplification factor, e.g., on the basis of an operational amplifier (OA). The present paper is devoted to the

solution of problems originating during design and use of a PU based on an OA. An approximation is offered for the transfer characteristics of the OA. Expressions are obtained for calculation of the voltages and currents of operation and reset and the resetting ratio of the relay units. Expressions are also obtained for the input resistances, one of the most important characteristics of a RU. The region is shown of permissible resistances of the signal sources for an inverting and a noninverting input. From the expressions derived it is possible to obtain the necessary condition of relay operation of an amplifier with a positive feedback. The errors of the RU are analyzed. For evaluation of the precision of the calculated resistances, an experimental test of the RU is made for variations of the resistances at the RU input and in the feedback circuit. The results of the experiments showed good agreement of the experimental results with the calculated (discrepancy not more than 2 percent), and high efficiency of regulation of the resetting ratio by the proposed method. The good agreement of the results of the experiment with the calculated is caused, not only by the proposed approximation, but also by the high amplification factor of the OA. Figures 3; tables 1; references: 9 Russian.

USSR

UDC [621.316.825:621.382].001.3

#### HIGH POWER SEMICONDUCTOR THERMORESISTORS

Moscow ELEKTROTEKHNIKA [Electrical Engineering] in Russian No 6, Jun 77  
pp 54-55

POPIVNENKO, V. V. and ZAYTSEV, YU. V., candidates in technical sciences;  
SHIRINSKAYA, N. N. and KROK, F. S., engineers

[Abstract] High power thermoresistors are most effectively used in the starting regulation devices of electric drives, in power oscillating tubes, lighting installations, etc., With the development of the "honeycomb" design of high power semiconductor thermoresistors in the early 1950's, it became possible to achieve a high degree of heat rejection by the use of forced air cooling. Circuits are presented illustrating how these devices can be used to automate the process of starting of electrical machines, achieving smooth control utilizing only the properties of the thermoresistors, eliminating the need for relays and minimizing the number of contacts required. Semiconductor thermoresistor starting devices do not distort the line current curve. Figures 4; references: 3 Russian.



USSR

UDC 621.3.045

## QUESTIONS RELATING TO INCREASING THE EFFICIENCY OF MANUFACTURING RING WINDINGS

Moscow PRIBORY I SISTEMY UPRAVLENIYA [Control Devices and Systems] in Russian No 8, 1977 pp 50-52

BILIBIN, K. I., candidate of technical sciences

[Abstract] This paper is devoted to ways of increasing the efficiency of manufacturing ring windings, with emphasis on mechanization and automation of auxiliary operations, most of which are now done by hand, associated with winding wire onto annular cores. These auxiliary operations include laying the wire on the core, setting up and fastening the core, feeding the wire onto the spool and fastening it to the core, insulating individual layers and the winding as a whole, treating leads, removing the finished winding or coil, preparation and finishing-up operations associated with resetting a machine tool for making windings of different sizes and types. The key technological parameter of the winding process is wire tension. At the present time the tension is selected by taking only the current-conducting core into account. Experimental research has demonstrated that the insulation should also be taken into account, especially for wires less than 0.5 mm in diameter. By taking the insulation into account it is possible to increase the maximum tension and, thus, wind at a faster rate. Many operations can be mechanized or automated, using program control. Multistep arrangements can increase the efficiency of winding equipment by a factor of three to five. Multistep arrangements reduce substantially the time required for auxiliary operations. As a rule of thumb, the time required for winding should be about five to 10 percent longer than that required for performing auxiliary operations. A description is given of a few devices and machine tools currently used for manufacturing ring windings, with emphasis on their advantages and limitations. Their operation is described in detail and illustrated. Extensive coverage is given to coil winding machines made by the Universal firm (USA). These universal machine tools have replaceable winding heads and tables, making it possible to wind annular cores of different standard sizes. Electronic counters and registers are provided for presetting the required number of turns. Ten winding heads of different design are supplied. Machine tools with program control are used for performing complicated processes, such as winding with nonuniform spacing. Universal makes a machine with program control for winding deflection system coils, which utilizes a continuous punched tape designed for making one type of coil. Time can be saved by winding the wire and insulating tape simultaneously, but this is feasible only for comparatively large windings. A description is given of a machine made by Universal which accomplishes this. Total automation of all operations is not possible for all winding systems. The direction for the future should be to create reliable high-speed machines with rapidly changeable winding heads and tables, as well as multistep and multipurpose machine tools. Special attention should be

devoted to mechanizing and automating auxiliary operations such as trimming and attaching leads and monitoring coil parameters in the winding process. Figures 4; references: 2 Russian.

USSR

UDC 621.315.61.539.294

#### INVESTIGATION OF VARNISH AND LACQUER DIELECTRIC COATINGS OF WAVEGUIDES

Moscow ELEKTROSVYAZ' [Electric Communication] in Russian No 7, Jul 77  
pp 30-32 manuscript received 2 Jun 75

NOVGORODSKAYA, G. YE., TYURINA, V. M., FEDOSEYEVA, YE. G., ISAYENKO, YU. M.  
and NAYDA, B. P.

[Abstract] The results are presented of a comparative investigation of the interior dielectric coatings of waveguides fulfilled on the basis of phenolformaldehyde resin (SB-1S varnish) and epoxydypolyamide enamel (Type EP-140) coatings. The investigations made it possible to recommend the use in circular waveguides of EP-140 enamel instead of coatings on the basis of SB-1S varnish. Figures 1; tables 1; references: 4 Russian.

USSR

UDC 666.291.3

#### NEW ENAMEL FOR PAINTING OF INSTRUMENTS

Moscow PRIBORY I SISTEMY UPRAVLENIYA [Control Devices and Systems] in Russian No 6, 1977 p 61

AKILOV, I. I., PAVLOVA, F. A., BERDNIKOV, A. YE., and ALESHCHENKOV, V. A.

[Abstract] In the majority of cases the assortment of enamels available at present for painting instruments does not satisfy the requirements for instrument manufacture with respect to performance characteristics, as well as the color range of the contemporary requirements of technical esthetics. The technical requirements for instrument enamels to be used in instrument manufacture were unified by the Yaroslav PTNII [Planning, Technological and Scientific-Research Institute] and transmitted to the GIPI [State Research and Planning Institute] LKP [expansion unknown] in Moscow. In accordance with these requirements GIPI LKP developed the ML-279 melamine-alkyd semi-gloss enamel. ML-279 enamel is a suspension of pigments and fillers in a mixture of alkyd and melamine-formaldehyde resins with the addition of a dryer. In comparison with the ML-12 enamel previously used, the new enamel

has better covering power and gives a higher-grade coverage. The ML-279 was tested at the Batum Climatic Station under humid subtropical conditions in a room, under a canopy and in the open air. It completely endured tests of the "Tropics P" cycle and can be exploited according to category OZh<sub>2</sub> (GOST 9.009-73). The enamel is applied by the pneumatic spraying method and by spraying in an electrostatic field. ML-279 has been introduced into a number of instrument manufacturing enterprises with an economical effected of 3000-4000 rubles per 1 T of enamel.

## CZECHOSLOVAKIA

### INTERNATIONAL EXPOSITION OF ELECTRONIC EQUIPMENT

Prague SDELOVACI TECHNIKA in Czech Vol 25, No 7, Jul 77 pp 250-252

GRECNER, JAN, engineer

[Abstract] The article reviews the 20th International Exposition of Electronic Equipment held in Paris. There were 1200 firms represented and 76,000 visitors registered. The fields covered were: computers, automobiles, electroacoustics, electronic components, medicine, telecommunications, energy supply, consumer goods, transportation and military equipment. Only IBM among the US manufacturers buys French components for their products. Most advanced equipment was shown by US manufacturers: General Electric, Texas Instruments, Honeywell, Fairchild, Hewlett Packard, General Instruments, and Rockwell. Among European manufacturers were: Signetics (Phillips), Siemen, and the LETI Laboratories. Czechoslovakia was represented by TESLA and PZO KOVO. Classical electronic components marketed abroad by these two firms were shown. The exposition demonstrated that high quality and reliable electronic apparatus depends on the quality and reliability of individual components used in the assembly. Many innovations in such component equipment were shown by the manufacturers represented. Generally the overall quality of electronic equipment is increasing with time. New items displayed consisted mainly of complex, highly integrated apparatus. Figures 4.

USSR

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DETERMINATION OF OPTIMUM CONTROL ACTIONS IN POWER SYSTEM EMERGENCY  
AUTOMATION

Moscow ELEKTRICHESTVO [Electricity] in Russian No 8, 1977 pp 7-13 manuscript  
received 4 Jan 77

OKIN, A. A., engineer TsDU YeES SSSR [Central Dispatching of the Integrated  
Power System of Socialist Countries. European Economic Community. USSR]

[Abstract] From the point of view of the theory of optimum systems, the distinctive properties of the actions of emergency automation consist in the presence of controls only at certain parts of a calculated interval and a fixed (assigned) number of switchings of control. A numerical method of determining the actions of automation in power systems must permit a combined calculation of these controls along with the controls effective with respect to an assigned time program. The present paper considers the special features of an emergency control in power systems for enhancement of the stability essential to this theory. A modified method of local variations for use in programs of calculation of the control actions of emergency automation is described. Algorithmization of the method and a numerical solution on a digital computer required construction of a formalized scheme of search which permits calculation of various control actions used in power systems. An experimental program realizing the modified method of local variations described was composed for the M-222 digital computer and the program's convergence and high speed were tested on a number of examples. The method of use of the programs of optimization of the actions of emergency automation is illustrated, using as an example automation intended for maintenance of stability with respect to an intersystem connection. Figures 6; tables 1; references: 7 Russian.

USSR

UDC [621.315.1:621.316.925.2].001.5

CONCERNING ADDITIONAL POSSIBILITIES OF THREE-PHASE AUTOMATIC RECLOSING  
ON 'WEAK' INTERSYSTEM TIE LINES

Moscow ELEKTRICHESTVO [Electricity] in Russian No 8, 1977 pp 74-75 manuscript  
received 13 Feb 76

KOLONSKIY, T. V., candidate in technical sciences, Kiyev

[Abstract] The suitability is well known of using devices for fast automatic 3-phase reclosing (APV) as a means of automation for rapid recovery of a network and maintenance of the stability of power systems with respect to intersystem tie lines, with self-eliminating short circuits on these lines.

Although the use of existing principles of rapid APV encounters serious difficulties on tie lines, at one side of which an electrical station is connected, the present paper shows the suitability of using 3-phase automatic closure with control from the side of the electrical station on "weak" intersystem tie lines. The principles are considered of fulfillment of control of APV without additional passage of time, as well as the peculiarities of a combination of such APV and an anti-emergency regime of automation. Figures 4; references: 2 Russian.

USSR

UDC 621.315.213.14.001.5

#### FLEXIBLE HIGH-FREQUENCY POWER CABLE

Moscow ELEKTROTEKHNIKA [Electrical Engineering] in Russian No 6, Jun 77  
pp 49-51

SIDYAKIN, V. F., candidate in technical sciences and GRITSAYENKO, V. A.,  
engineer

[Abstract] A design is suggested for a flexible high-frequency power cable in order to reduce the inductance of the cable. Each conductor of the cable is divided into a number of smaller conductors or "rays." The rays are then placed in checkerboard order for the two phases, which significantly reduces the mean of magnetic field intensity in the space occupied by the cable, even in comparison with coaxial cable. The magnetic field is localized in the space actually occupied by the conductors. Cable design, according to the new method, is based on assignment of the total cross section of the cable on the basis of the current which it must carry, calculation of the capacitance and inductance of the cable and iterative calculation of the number of rays which will be required to reduce total inductance to the point where sufficient current can be carried over the distance required at the frequency which must be carried. Figures 1; references: 2 Russian.

USSR

## TRANSMISSION OF ELECTRIC POWER OVER GREAT DISTANCES

Moscow VESTNIK AKADEMII NAUK SSSR [Bulletin of the Academy of Sciences, USSR] in Russian No 7, 1977 pp 11-15

ROKOTYAN, S. S., dr in technical sciences and chief engineer of "Energoset'-proyekt" [All-Union State Planning, Surveying and Scientific-Research Institute of Power Systems and Electric Power Networks]

[Abstract] This entry discusses the current status of developments aimed at solving the problem of transmitting electric power over great distances, in connection with formation of the USSR Unified Electric Power System (YeEES). Rokotyan's report delivered at a meeting of the Presidium of the USSR Academy of Sciences is presented, along with a synopsis of commentaries made by members and a decree of the presidium relating to the issues discussed. The central problem concerns the fact that key energy resources, coal, in particular, are located in the eastern regions of the USSR, while the main consumers are principally located in the western regions, in the European sector. Studies have shown that neither rail transport of coal, pipelining of gas, nor nuclear power plants offer the best reliability and economic efficiency. The solution agreed upon by the majority is to develop a d.c. power transmission line, permitting generation of power in areas remote from consumers in the west and at the site of energy resources, and eliminating transportation problems. The use of inexpensive coal from the Kansk-Achinsk area is cited as a particular advantage of this solution. Experimental studies are now under way on the proposed Ekibastuz-Center 1500 kV, 6000 MW d.c. line. Feasibility studies are being conducted on an Itak-European Sector line. The Ekibastuz-Center line utilizes bipolar + 750 kV transmission, with the center tap of transformers directly grounded; the line is an aerial transmission line with leads measuring  $4 \times 1000 \text{ m}^2$  per pole; towers are metal; the transfer circuit utilizes two parallel branches consisting of four cascading bridges, 187.5 kV, 375 MW, 2000 A, 12-phase; efficiency is rated at 85 percent; rectifiers are high-voltage thyristor units. For formation of a reliable YeEES it is of decisive importance to have high-power d.c. transmission lines connecting the United Electric Power System (OEES) of the eastern section of the country with the European and Urals OEES's. A line with greater carrying capacity is also required for internal connections in the Asian and European OEES's. The problem of d.c. transmission is cited as the most strategic problem in the development of power engineering in the USSR. The need for creation of d.c. circuit breakers is emphasized; solution to this problem will make it possible to hook up remote regions of the north to the unified system. For this purpose the presidium of the academy has directed that research be done on processes for suppressing high-power arc and on gas-insulated transmission lines for operation in the megavolt range. Further work is to be done to optimize high-voltage thyristor rectifiers. Construction of the Ekibastuz-Center line is to be begun in the present Five-Year Plan. Further work is to be done on the combined operation and stability of joint a.c. and d.c. networks in complicated power systems utilizing d.c. inserts.